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SPACE USE IN *LIOLAEMUS PSEUDOANOMALUS* (IGUANIA: LIOLAEMINAE) IN CENTRAL-WESTERN ARGENTINA

Héctor J. Villavicencio, Juan C. Acosta, Maria G. Cánovas and José A. Marinero.*

Abstract

We studied space use patterns in a population of the neotropical lizard, *Liolaemus pseudoanomalus*, in central-western Argentina. This is a terrestrial, diurnal lizard found in mostly arid habitats. We carried out censuses from August 2000 to August 2001, visiting the site every 10 days, between 0800 and 1900 hours. We recorded sex and age group of captured lizards (N = 101) and the type of microhabitat they were found in. Overall, most individuals (89.11%) were found under flat stones whereas the rest were found either on these stones (4.95%) or in open habitat (5.94%). Even in spring and summer, when the lizards were active, 86.42% were found under flat stones while only 13.58% were in the open. Compared to other species of the genus, this is an unexpected result. Other species of *Liolaemus* spend most of the time in the open during their active period. We discuss the result in light of thermoregulatory behavior and the particular characteristics of the stones, called flagstones.

In a general review, Smith and Ballinger (2001) found that the use of space in lizards affects important physiological, ecological and behavioral characteristics such as thermoregulation, digestive efficiency, metabolic rates, foraging behavior, reproduction, activity periods, escape tactics, among others. Each habitat and microhabitat have biotic and abiotic properties that probably generate specific consequences in the biology of lizards (Smith and Ballinger, 2001). In addition, the study of space use in lizards can give us the opportunity to understand other important parameters in the ecology of reptiles, such as the potential effects of modification, fragmentation, and irreversible destruction of the habitat, one of the main causes of the decline of the biodiversity in reptiles (Gibbons et al. 2000). Furthermore, understanding the spatial ecology of lizards allows us to generate alternatives (or suggest strategies) for the management and conservation of a particular species.

Liolaemus pseudoanomalus is a small desert lizard, restricted to open, sandy, flat areas in northwestern Argentina (Cei, 1986; Acosta and Murua, 1997; Avila et al., 2003). It is diurnal (Villavicencio et al. 2002, 2003a), insectivorous (Belver and Avila, 1999), oviparous (Villavicencio et al., 2003b), thermoconformer (Villavicencio et

al., 2001), and sexually dimorphic (Villavicencio et al., 2003c). Here, we investigate the use of space in this species during one year and discuss its possible relation to thermoregulation.

Materials and Methods

The study was carried out in a temporary creek bed near La Laja (31° 19'S, 68° 41'W), Albardón Department, San Juan Province, Argentina. The site is located in a typical environment for the species, corresponding to the phytogeographic province called Monte (Cabrera, 1994). The climate is very dry, with annual precipitation of less than 90 mm. The substrate is sandy with little vegetation (mostly shrubs). An important characteristic of this particular site is that it is scattered with numerous flat stones or flagstones.

We collected data every 10 days, from August 2000 to August 2001. We inspected bushes and lifted flagstones along a transect (20 x 100 m), within the selected area (Tellería, 1986), from 0800 to 1900 hours. We repeated the transect approximately 10 times each day that we made a census. When a flagstone was lifted, it was carefully replaced in its original position to avoid disturbing its possible use by the lizards.

Individuals were captured by hand. We recorded their sex and age group. We defined three age categories based on snout-vent lengths (using a Vernier caliper): neonates (up to 34.9 mm), juveniles (between 35 and 57 mm), and adults (over 57 mm). We also recorded the microhabitat type where a lizard was found. We used the following categories: 1) under flagstones, 2) on flagstones, 3) near vegetation, up to 2m, and 4) open habitat, at more than 2m from vegetation. We considered the following months within each austral season: winter (July to September), spring (October to December), summer (January to March), and autumn (April to June). We used a Chi-square goodness-of-fit test (Siegel and Castellan, 1988) to compare among categories (comparing "under flagstones" to the combined categories of "on flagstones", "near vegetation" and "in open habitat", due to low frequencies), with respect to all lizards and with respect to sex, age group, and season.

Results

A total of 101 individuals were captured during nine months (August to April), no lizards being found between May and July (Villavicencio *et al.*, 2002, 2003a). Most lizards were found under flagstones (89.1%), the rest being found on flagstones (4.9%), near vegetation and up to 2m (3%), and in open habitat at more than 2m from vegetation (3%, Table 1). The result of a Chi-square goodness-of-fit test comparing "under flagstone" to the other habitat categories, for all lizards, was

$X^2 = 61.79$ ($N = 101$, $df = 1$, $p < 0.001$). Results with respect to sex, age group, and season (except when values were too low to apply the test) are shown in Table 1. We never found more than one *L. pseudoanomalus* under the same flagstone although there was occasionally a gecko, *Homonota underwoodi*. As soon as they were spotted most individuals fled to nearby flagstones.

Discussion

Our results show that *Liolaemus pseudoanomalus* overwhelmingly chose to be under flagstones instead of on them or in open habitat as would have been expected in a diurnal species (see below). Males and females, as well as juveniles and adults were found significantly more often under flat stones than out in the open (Table 1). This pattern of space use did not vary in spring and summer, the lizards being found significantly more often under flagstones than in the open (Table 1). In autumn and in winter, although a few lizards were found under flagstones, no lizards were found in the open. We suggest that due to low temperatures, the lizards sought deeper refuges.

Table 1.- Number of *Liolaemus pseudoanomalus*, by sex, age group, and season with respect to microhabitat type. UF: under flagstones; OF: on flagstones; NV: near vegetation, up to 2m; OH: open habitat, over 2m from vegetation; X^2: Chi-square goodness-of-fit tests comparing UF with OF, NV, and OH combined, per sex, age group and season ($df = 1$ in all cases); p: significance level. Dashes indicate test was not applied. More details in Methods.

	UF	OF	NV	OH	X^2	P
Sex						
Males	54	3	2	2	36.21	< 0.001
Females	36	2	1	1	25.60	< 0.001
Age groups						
Neonates	5	0	1	0	—	—
Juveniles	47	0	0	1	44.08	< 0.001
Adults	38	5	2	2	17.89	< 0.001
Seasons						
Winter	11	0	0	0	—	—
Spring	50	2	2	2	34.57	< 0.001
Summer	20	3	1	1	9.00	< 0.01
Autumn	9	0	0	0	—	—

Many *Liolaemus* species are known to bask and thermoregulate in the sun. Examples are *L. melanops xanthoviridis*, *L. eleodori*, and *L. kingi baguali* (Cei, 1986); *L. fuscus*, *L. monticola* and *L. nigroviridis* (Carothers et al., 1998); *L cuyanus* and *L koslowskyi* (Martori et al., 2002; Avila et al., 2003); *L. quilmes* (Halloy y Robles, 2002); *L. sanjuanensis* (Acosta et al., 2004); and *L darwinii* (pers. obs). However, lizards of *L. pseudoanomalus*, at the study site, seem to thermoregulate in a different way, i.e., by lying under flagstones (also reported in Avila et al., 2003), where they apparently find a microclimate that enables them to regulate their body temperatures during the months of activity. When temperatures fell, and lying below a flagstone was not adaptive any longer, the lizards found deeper refuges to spend the colder months (Villavicencio et al. 2002, 2003a).

More research is needed in order to understand, how choosing to be under flagstones instead of out in the open, may affect this lizard's foraging behavior. It has been described as a sit and wait forager and is characteristically not too mobile (Belver y Avila, 1999). Spending long periods under flagstones may also diminish its vulnerability to natural predators (such as a few rapacious birds and colubrids like *Bothrops ammodytoides* and *Philodryas trilineatus*). It would be important to compare this population to other populations of *L. pseudoanomalus* where flagstones might not be available.

We found only one other report that indicated that another *Liolaemus*, *L. lutzae*, spent 90% of their activity period under detritus (Duarte da Rocha, 1988). This author suggests that by staying under detritus, the lizards found not only a foraging site but shelter from potential predators and that they were also protected from critical temperatures. In this study, the thermal properties of the flagstones may be creating microclimate pockets that help the lizards remain within a certain range of body temperatures and thus their choice to be under a stone instead of over it.

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The Nomenclatural Status of Australian *Ramphotyphlops* (Serpentes: Typhlopidae)

Van Wallach

Abstract

A new genus, *Austrotyphlops,* is proposed for the typhlopid clade from Australia and southern New Guinea currently known as *Ramphotyphlops.* The names *Libertadictus* and *Sivadictus* of Wells and Wellington (1984-1985) are discussed and dismissed as unavailable *nomina dubia* because their diagnoses are inaccurate and composite. The species of the genera *Ramphotyphlops* and *Austrotyphlops* are enumerated.

Introduction

Although the genus *Ramphotyphlops* Fitzinger (1843) is listed as comprising nearly 60 species (Wallach, 1998; McDiarmid et al., 1999), the exact content is unknown. As currently conceived, the genus is limited to the Australasian region with the sole exception of *R. braminus* (Daudin, 1803), the parthenogenetic 'flower pot' snake, which has colonized much of the world with human assistance. Robb (1966b) resurrected the generic name *Ramphotyphlops,* based upon her anatomical work (Robb, 1960, 1966a), for those species of typhlopids possessing a solid awn-like protrusible hemipenis that retracts into the tail in a helical manner in addition to the presence of cloacal pouches (= retrocloacal sacs of Guibé, 1948) in the posterior body cavity. McDowell (1974), believing he had discovered an earlier available name for this assemblage of snakes, introduced the name *Typhlina* Wagler (1830) in place of *Ramphotyphlops.* The name was employed by Hahn (1980) and others until it was realized that *Typhlina* Wagler is preoccupied by *Typhlina* Ehrenberg, 1828 *in* Hemprich (1828-1845), whereupon the name reverted back to Fitzinger's *Ramphotyphlops.* Wallach (1995) separated the *R. subocularis* species group from *Ramphotyphlops* and placed the four recognized species in *Acutotypohlops.* Both genera share these male reproductive specializations that are unique within the Scolecophidia and hence are sister taxa.

In addition to *Acutotyphlops* and all Australian *Ramphotyphlops,* other species that are known to have the coiled hemipenis and retrocloacal sacs from Southeast Asia and the East Indies include *R. acuticaudus, R. albiceps, R. angusticeps, R. becki, R. cumingii, R. depressus, R. erycinus, R. flaviventer, R. lineatus, R. multilineatus, R. olivaceus, R. polygrammicus,* and *R. willeyi* (Wallach, 1998: Table

10). The number of coils in the retracted hemipenis varies from 0.5-15, although coils are lacking in the Philippine *R. cumingii* and the Australian *R. guentheri* and *R. nema* (Wallach, 1998). Retrocloacal sacs range in length from 0.4-7.0% SVL.

Since these two characters are only present in male specimens, some researchers refuse to recognize the validity of *Ramphotyphlops* (Lazell, 1988, 2002). As of yet no other characters are known to separate female *Ramphotyphlops* from *Typhlops* and species known only from females in the Indo-Australian region therefore cannot be positively allocated to either genus. Unfortunately, a number of species from this region have not yet been examined or are only known from females (i.e., *Cyclotyphlops deharvengi, R. braminus, R. exocoeti, R. leucoproctus, R. mansuetus, R. marxi, R. similis, R. suluensis, R. supranasalis, Typhlops ater, T. bipartitus, T. bisubocularis, T. conradi, T. depressiceps)* or from types that have been lost or destroyed (i.e., *Typhlops hypsobothrius, T. lorenzi).*

Two lineages of *Ramphotyphlops* were detected in a phylogenetic analysis (Wallach, 1998: Fig. 4): a basal clade of Australian-southern New Guinean species and a derived clade of East Indian (Indonesia-Philippines-northern New Guinea-Pacific Islands) species. Since the Australian typhlopids appear to be a monophyletic group and all examined species possess *Ramphotyphlops*-like reproductive structures, it can be assumed that all Australian species share these same reproductive structures. However, the type species of *Ramphotyphlops* is *Typhlops multilineatus* Schlegel (1839), an Indonesian taxon. Thus the name *Ramphotyphlops* is tied to the Indonesian clade of species, necessitating a new generic name for the Australian clade.

Only two generic names are potentially available for typhlopid species inhabiting Australia: *Libertadictus* Wells and Wellington (1984) with the type species *Onychocephalus bituberculatus* Peters (1863), and *Sivadictus* Wells and Wellington (1985a) with the type species *Anilios nigrescens* Gray (1845). *Libertadictus* has priority over *Sivadictus*. However, the wholesale splitting of genera and resurrection of all synonyms and subspecies to full species status for the entire Australian and New Zealand herpetofaunas (Wells and Wellington, 1984, 1985a-b) unleashed a torrent of outcries and appeals for the suppression of the three works by the ICZN (Gans, 1985; Grigg and Shine, 1985; King and Miller, 1985; Monteith, 1985; Tyler, 1985; Thulborn, 1986; Australian Society of Herpetologists, 1987; Shea, 1987; Heatwole et al., 1988; Hutchinson, 1988; Ingram and Covacevich, 1988; King, 1988; Stone, 1988; Tyler, 1988; Adler, 1989) although some researchers opposed rejection (Birrel et al., 1988; Dubois et al., 1988; Greer, 1988; Holthius, 1988; Meyer-Rochow, 1988; Anonymous, 1989; Bouchet et al., 1990). What is unsettling is that Wells and Wellington (1985a)

stated that they intended to publish a similar reclassification of the reptiles and and amphibians of the world in the future, and they even cite "A Synopsis of the Amphibia and Reptilia of New Guinea and Adjacent Islands" in their bibliography as being "in press" but with a 1985 publication date. This paper has thankfully never appeared. Wells and Wellington (1984) made 282 taxonomic changes, Wells and Wellington (1985a) made 447 changes, and Wells and Wellington (1985b) made 10 changes for a grand total of 739 taxonomic changes. These included 107 new genera, 470 new species, and 104 lectotype designations (Aust. Soc. Herp., 1987), supported by 502 fabricated references by the authors from the 'Australian Herpetologist' in 1983-1984 (Wells and Wellington, 1985a). The ICZN (1991) decided that even though Wells and Wellington displayed contempt for the Code and its provisions and that the case for suppression was strong, the issues involved were of a taxonomic nature rather than nomenclatural one and best left for individual taxonomists to deal with, any request for suppression being concerned with names rather than works.

Libertadictus was established as a monotypic genus by Wells and Wellington (1984) for the species *Ramphotyphlops bituberculatus.* The genus was diagnosed by the following combination of characters: midbody scale rows 20, snout trilobed in dorsal view, snout angular in lateral view, maximum snout-vent length 170 mm, nasals semidivided, superior nasal suture not visible dorsally, rostral shield-shaped, and length/width ratio 40-90. All of these characters fit the type species except for length, which is 450 mm. Wells and Wellington (1985) then expanded *Libertadictus* to include another 13 species (Table 1). Examination of Table 1 reveals that midbody scale rows in the group vary from 16-24, which is the maximum range in all Australian typhlopids. In comparing the dorsal snout shape, a distinctly trilobed contour is only present in *R. bituberculatus* but another nine species have a weakly trilobed appearance and four species have a rounded contour. In lateral profile all species are angular except *R. ammodytes* and *R. diversus.* All included species have snout-vent lengths greatly exceeding 170 mm; total length (which is nearly equal to snout-vent length) ranges from 300-700 mm. A completely divided nasal is presnt in five species and the superior nasal suture is visible dorsally in three species. Thus, none of the characters proposed by Wells and Wellington (1984) for their genus *Libertadictus* define the expanded group of Wells and Wellington (1985). In fact, the only species for which the characters apply (excepting snout-vent length) are *R. bituberculatus, R. pinguis,* and *R. waitii.* It is clear that the genus *Libertadictus* is insufficiently diagnosed and should therefore be considered a *nomen dubium.*

The genus *Sivadictus* Wells and Wellington (1985) was established for 20 species (six of which were resurrected from synonymy) in addition to the type species of *R. nigrescens.* It was diagnosed by the following characters: lacking obvious

Table. 1. Synopsis of taxonomic characters of *Libertadictus*. MSR = midbody scale rows, TDS = trilobed snout (dorsal view), ALS = angled snout (lateral view), SVL = maximum snout-vent length (mm), ND = nasals divided, SNS = superior nasal suture visible dorsally, L/W = total length/midbody diameter ratio

Species	MSR	TDS	ALS	SVL	ND	SNS	L/W
bituberculatus (type species)	20	++	+	450	0	0	40-90
ammodytes	20	0	0	352	0	+	?
batillus	24	0	+	320	+	+	53
centralis	20	0	+	320	0	0	60-69
diversus	20	0	0	352	+	0	40-70
endoterus	22	+	+	376	0	0	40-60
grypus	18	+	+	415	+	0	60-120
hamatus	22	+	+	418	0	0	29-60
leptosomus	16	+	+	375	+	0	70-88
margaretae	18	+	+	306	0	0	?
pinguis	20	+	+	485	0	0	20-30
proximus	20	+	+	700	0	+	20-40
unguirostris	24	+	+	610	+	0	38-70
waitii	20	+	+	614	0	0	57-80

cephalic glands, snout rounded in dorsal and lateral views, and dorsal rostral broadly oval. Reference to Table 2 shows that cephalic glands are conspicuous in seven species (including the type species), obscure in eight species, and unknown in six species. All species except two have rounded dorsal snouts and three species have angular lateral snouts. Eight species lack broadly oval rostrals. Again, the definition of *Sivadictus* does not define the group of included taxa. Only two species fall within the definition of Wells and Wellington *(R. micromma* and *R. wiedii)* and neither are the type species!

Although at least one Wells and Wellington name has been adopted by the scientific community (*Antaresia fide* Kluge, 1993), neither of the typhlopid names

has been considered valid by any Australian worker (Storr et al., 1986, 2002; Griffiths, 1987, 1997; Cogger, 1988, 1992, 2000; Wilson and Knowles, 1988; Gow, 1989; Hoser, 1989; Shine and Webb, 1990; Swan, 1990, 1995, 1998; Weigel, 1990; Covacevich and Couper, 1991; Coventry and Robertson, 1991; Shine, 1991; Ehmann, 1992;

Table 2. Synopsis of taxonomic characters of *Sivadictus* (taxa revived by Wells and Wellington but not currently recognized in quotation marks). CG = cephalic glands (C = conspicuous, O = obscure, A = absent), RDS = rounded dorsal snout profile, RLS = rounded lateral snout profile, BOR = broadly oval rostral (dorsal view)

Species	**CG**	**RDS**	**RLS**	**BOR**
nigrescens (type species)	C	+	+	+
affinis	O	+	0	+
australis	C	0	0	+
"bicolor"	?	+	+	+
broomi	C	+	+	+
"curtus"	?	+	+	0
guentheri	C	+	+	+
howi	O	+	+	0
"kenti"	?	+	0	+
kimberleyensis	O	+	+	0
ligatus	O	+	+	0
micromma	O	+	+	+
minimus	C	+	+	+
"nigricauda"	?	+	+	+
"preissi"	?	+	+	+
"reginae"	?	0	+	0
tovelli	C	+	+	0
troglodytes	O	+	+	0
wiedii	C	+	+	+
yampiensis	O	+	+	0
yirrikalae	O	+	+	+

Ehmann and Bamford, 1993; Webb and Shine, 1993; Bush et al., 1995; Greer, 1997; Shea, 1999; Alpin and Smith, 2001; Cronin, 2001; Wilson and Swan, 2003; Swan et al., 2004), any taxonomic list (Dowling, "1988," Ferrarezzi, 1994; Frank and Ramus, 1995; Mattison, 1999; McDiarmid et al., 1999), or any herpetology text (Zug, 1993; Pough et al., 1998, 2001, 2004; Zug et al., 2001). The only work in which *Libertadictus* has appeared subsequent to its publication is Williams and Wallach (1989), where it was considered a synonym of *Ramphotyphlops.*

Taxonomy

I take this opportunity to propose a new name for the clade of Australian-New Guinea typhlopids currently known as *Ramphotyphlops.*

***Austrotyphlops* nov. gen.**

Type species.– *Anilios nigrescens* Gray, 1845.

Diagnosis.–All members of the Australian-New Guinean clade of blindsnakes having retrocloacal sacs and solid eversible awned hemipenes that retract into the tail in a helical pattern.

Content.–*Austrotyphlops affinis* (Boulenger, 1889), *A. ammodytes* (Montague, 1914), *A. aspina* (Couper, Covacevich and Wilson, 1998), *A. australis* (Gray, 1845), *A. batillus* (Waite, 1894), *A. bituberculatus* (Peters, 1863), *A. broomi* (Boulenger, 1898), *A. centralis* (Storr, 1984), *A. chamodracaena* (Ingram and Covacevich, 1993), *A. diversus* (Waite, 1894), *A. endoterus* (Waite, 1918), *A. ganei* (Alpin, 1998), *A. grypus* (Waite, 1918), *A. guentheri* (Peters, 1865), *A. hamatus* (Storr, 1981), *A. howi* (Storr, 1983), *A. kimberleyensis* (Storr, 1981), *A. leptosomus* (Robb, 1972), *A. ligatus* (Peters, 1879), *A. longissimus* (Alpin, 1998), *A. margaretae* (Storr, 1981), *A. micrommus* (Storr, 1981), *A. minimus* (Kinghorn, 1929), *A. nema* (Shea and Horner, 1997), *A. nigrescens* (Gray, 1845), *A. nigroterminatus* (Parker, 1931), A. *pilbarensis* (Alpin and Donnellan, 1993), *A. pinguis* (Waite, 1897), *A. proximus* (Waite, 1893), *A. robertsi* (Couper, Covacevich and Wilson, 1998), *A. silvia* (Ingram and Covacevich, 1993), *A. splendidus* (Alpin, 1998), *A. tovelli* (Loveridge, 1945), *A. troglodytes* (Storr, 1981), *A. unguirostris* (Peters, 1867), *A. waitii* (Boulenger, 1895), *A. wiedii* (Peters, 1867), *A. yampiensis* (Storr, 1981), *A. yirrikalae* (Kinghorn, 1942). Representatives of all species except *A. ammodytes, A. aspina, A. batillus, A. ganei, A. howi, A. kimberleyensis, A. longissimus, A. margaretae, A. micrommus, A. robertsi, A. splendidus, A. troglodytes, A. yampiensis,* and *A. yirrikala* were examined by Wallach (1998). These species are either known solely from the types, or were published too late for inclusion in Wallach's analysis.

The following species currectly classified as *Ramphotyphlops,* but occurring on nearby Christmas Island, northern New Guinea, the Solomon Islands, and New Caledonia, could possibly be members of *Austrotyphlops: R. angusticeps* (Peters, 1877), *R. becki* (Tanner, 1948), *R. erycinus* (Werner, 1901), *R. exocoeti* (Boulenger, 1887), *R. leucoproctus* (Boulenger, 1889), *R. mansuetus* (Barbour, 1921), *R. polygrammicus* (Schlegel, 1839), and *R. willeyi* (Boulenger, 1900). Representatives of all species except *R. leucoproctus* were examined by Wallach (1998) and they clustered with the Southeast Asia-East Indies clade.

Etymology.–A generic name of masculine gender derived from the Latin *austral,* meaning southern in reference to the continent of Australia, and the Greek *typhlops,* meaning blind, thus southern blind snakes. Although it is considered by some to be improper to combine Greek and Latin terms when composing a name, the alternative to *Austrotyphlops* would be *Nototyphlops,* employing the Greek term for south *(noto-).* However, since the majority of the included species are endemic to Australia, it is felt that taxonomy and nomenclature are better served using the composite *Austrotyphlops.*

Range.–Australia and southern New Guinea.

Conclusions

Based upon the only available phylogenetic hypothesis of scolecophidian relationships (Wallach, 1998), *Ramphotyphlops* is paraphyletic and consists of two distinct clades: an Australian-southern New Guinea clade and a Southeast Asian-Indonesian clade. Following the principle of phylogenetic definitions of taxon names (De Queiroz and Gauthier, 1990), only monophyletic groups are named. As the type species of *Ramphotyphlops (R. multilineatus)* belongs to the Southeast Asian-East Indies clade, the Australian clade can no longer be considered as *Ramphotyphlops* and a replacement name is needed. The only two available names applicable to the Australian typhlopids are *Libertadictus* Wells and Wellington (1984) and *Sivadictus* Wells and Wellington (1985a). Both of these names are shown to be composite and insufficiently diagnosed, thereby dismissed as *nomina dubia.* A new name, *Austrotyphlops,* is proposed for the monophyletic clade of typhlopids inhabiting Australia and New Guinea.

Removal of the Australian members of *Ramphotyphlops (sensu lato)* from the genus leaves the following unquestionable members in *Ramphotyphlops (sensu stricto): R. acuticaudus* (Peters, 1877), *R. albiceps* (Boulenger, 1898), *R. cumingii* (Gary, 1845), *R. depressus* (Peters, 1880), *R. flaviventer* (Peters, 1864), *R. lineatus* (Schlegel, 1839), *R. multilineatus* (Schlegel, 1839), *R. olivaceus* (Gray, 1845),

and *R. ozakiae* Wallach and Piyawan, 1999. Since both *Typhlops* and *Ramphotyphlops (sensu lato)* occur in Malaysia, the Philippines, Indonesia, and New Guinea, certain species presently assigned to *Ramphotyphlops* because of distribution or taxonomic characters for which the male reproductive structures (hemipenis and retrocloacal sacs) are unknown may in fact be members of *Typhlops.* These include *R. braminus* (Daudin, 1803), *R. exocoeti* (Boulenger, 1887), *R. leucoproctus* (Boulenger, 1889), *R. lorenzi* (Werner, 1909), *R. mansuetus* (Barbour, 1921), *R. marxi* (Wallach, 1993), *R. similis* (Brongersma, 1934), and *R. supranasalis* (Brongersma, 1934).

To complicate matters even further, in light of the ability of typhlopids to easily disperse over sea in soil and wood (uprooted trees or ship timbers) and since the male reproductive structures of the following typhlopid species have yet to be examined or else the species are only known from females or the type specimens have been lost, they may also be members of either *Ramphotyphlops* or *Austrotyphlops: Cyclotyphlops deharvengi* Bosch and Ineich, 1994, *Typhlops bipartitus* Sauvage, 1879, *T. coecatus* Jan, 1863, *T. domerguei* Roux-Estève, 1980, *T. hypsobothrius* Werner, 1917, T. *khoratensis* Taylor, 1962, *T. leucomelas* Boulenger, 1890, *T. lankaensis* Taylor, 1947, *T. malcolmi* Taylor, 1947, *T. schmutzi* Auffenberg, 1980, *T. tenebrarum* Taylor, 1947, *T. veddae* Taylor, 1947, *T. violaceus* Taylor, 1947, and *T. zenkeri* Sternfeld, 1908. Until the male reproductive structures are known and a phylogenetic analysis is performed upon all typhlopid species from Southern and Southeastern Asia, the Philippines, Indonesia, Papua New Guinea, Australia, and all Indian Ocean and Pacific Ocean islands, including both molecular and morphological characters, the exact content of each genus will be speculative.

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Periodic Species Abundance in Snakes

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Over the years, driving roads while looking for snakes, I have noticed that a particular species is extremely common one year and then seems to disappear, sometimes, for many years. I have observed this here in Maryland as well as in other states.

The last twenty years, I have been driving a 14.3-mile "loop" near my home in Anne Arundel County, Maryland. During the season, I try and drive this "loop" every day at about the same time. During the first sixteen years it was usually at dusk, looking for live snakes, however the last four years it was usually about 4 PM searching for AOR's or DOR's. Driving roads searching for snakes is well documented in the literature (Ashley and Robinson, 1996), (Dodd, Enge and Stuart, 1989), (Fitch, 1949), (Kauffeld, 1957), (Gibson & Merkle, 2004), (Martin, 1976), (Rosen and Lowe, 1994).

On 2 October 1960, while driving roads, Howard W. Campbell and I collected a large *Lampropeltis c. rhombomaculata* in, what is now, my study area here in Anne Arundel County, Maryland. On 15 October 1960, John E. Cooper, Howard W. Campbell and Richard Franz (Cooper, 1961) found two DOR specimens on the roads in Charles County, Maryland which represented at the time a new county record. On 1 November 1960, Robert Simmons and Howard W. Campbell collected an additional DOR Charles County specimen. Cooper (1961) reported on this and a specimen found DOR on 11 or 12 October 1960 in St. Mary's County, Maryland, also a new county record at that time. This represents five specimens in one month. We all have spent many hours driving these same areas with out ever seeing this species.

In my study area, this species did not show up again until the early October 1993, when I found three specimens DOR near the junction of New Cut Road and Gambrils Road within several days. In this area from 1986, when I started regularly driving these roads, until the present, these were the only specimens of *L. c rhombomaculata* seen.

Since mole snakes are rather uncommon, and I have quite a few records. I will summarize the data on hand giving month and year for the data available. This indicates my point that when multiple specimens are found in a relatively short time frame (ex. several days), it is a periodic abundance.

In 1959, at least three specimens were collected, two in Anne Arundel County, one 15 February, a DOR, on Mountain Road at Old Annapolis Road, and one 23 May, off MD Rt. 554 in Severn (Harris, 1975). One specimen was collected in Howard County in August 1959 (Miller, 1984).

Individual specimens have been found in the intervening years from 1960 to 1993 [March 1963 (Harris/Field notes), September 1964, May 1965 (male and female together under paper) (Harris/Field Notes), August (9 hatchlings), September 1966, June 1969, September 1971, November 1973 (2 specimens from different localities)] in Anne Arundel, Howard and Prince George's Counties, Maryland (Grogan 1971, 1974) (Miller, 1982) (Harris, 1975). Additional historical records can be found in Howden (1946). R. S. Simmons collected one specimen in August 1950, and that specimen is in the collection at the NHSM. Other than the nine hatchlings, and one pair found together, these records represent individual specimens found at a given locality.

In my study area, in Anne Arundel Co. Maryland, *Thamnophis s. sirtalis* is seen occasionally. Some years you may see a dozen specimens, other years a few. During the latter part 2005, they were everywhere. Two or three specimens a day were not uncommon. From 9 May through 8 November 2005, 109 specimens were found DOR. In 2004 for contrast, from 21 April to 19 October 2004, only 6 *T. s. sirtalis* were found DOR or AOR.

Coluber c. constrictor is relatively uncommon in my study area. You can usually count on one hand the number of specimens seen in a given year. In 2004, only one specimen was found on 15 October. In 2005, however, from 23 May to 15 October, 20 specimens were found. This is more specimens, of *C. c. constrictor,* than I have seen in my study area before. Is their abundance on the roads in response to the abundance of DOR *T. s. sirtalis*?

Opheodrys aestivus was also more abundant in 2005 than in previous years, with a total of 15 specimens found DOR in my study area in Anne Arundel County. In 2004, only I specimen was observed. And during the prior 18 years, only one other specimen was collected. In July 1965, *O. aestivus,* was particular abundant on the initial stretch of Lake Shore Drive, Anne Arundel County. Both Jack Ruppert, who lived at the time off Lake Shore Drive, and my self found many DOR's there.

Elaphe o. obsoleta is usually by far the most abundant species in my study area. In 2004, from 15 May to 27 September, 13 specimens of *E. o. obsoleta* were found. In 2005, from 11 May to 13 November, 39 specimens were found.

My wife, Iveta Stegmar, has been taking walks along Old Mill bottom Run,

off of Old Mill Bottom Road, in Annapolis, Maryland for the past eight years. Occasionally she would see a DOR and bring it home. She picked up the usual *Thamnophis s. sirtalis, Diadophis p. edwardsi, Elaphe o. obsoleta,* and *Eumeces fasciatus*. In November 2005, she brought home a total of thirteen *Storeria d. dekayi,* a species she had never seen there before. On three days she walked, 1, 3 and 8 November 2005, she collected at total of 13 specimens, 9 DOR and 4 AOR. No other species were observed on these days.

During spring trips to the SE, terminating in Florida, over many years, driving roads at night was a productive way of collecting representative examples of the local fauna. Although I never did, several of my friends who also make these spring trips, and those at the Universities occasionally would collect a *Cemphora* on the roads.

During the evening and nights of 10-12 June 1969, Robert S. Simmons and I collected 10 *Cemphora c. coccinea* crossing roads, most after midnight and up until 4:00 AM. In Levy Co. Florida, with Howard W. Campbell, we collected three. In Franklin Co. with Clive Longden and Bruce Means, we collected three. The remaining specimens we also collected in Franklin Co., Florida.

The periodic abundance observed in some years is probably due to a combination of events, such as weather and a proliferation of prey species and is probably periodic rather than cyclic. Further investigation is warranted.

This note only reflects some examples I have notice in my years of collecting. A detailed search of the literature would be worthwhile.

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Serum Electrophoretic Patterns in a Select Group of Mexican Montane Rattlesnakes (*Crotalus*).

Herbert S. Harris, Jr.

In the early 1970's with the increasing amount of Mexican Montane Rattlesnakes available, there seemed to be problems in identification. I had received specimens identified as *Crotalus triseriatus aquilus*, which did resemble that species, but to me, appeared to be closer to *Crotalus lepidus*. Harris and Simmons (1978) recognized that *Crotalus aquilus* was good species, being intermediate between *C. triseriatus* and *C. lepidus*. This paper will follow some of the steps that led to that conclusion and others in Harris and Simmons (1978).

With the large collection of rattlesnakes that I maintained there were observations that one could make that may have been missed working only with preserved material. One such observation was that *C. lepidus* snakes almost always had at least one mal-colored scale on the underside of the lower jaw. I started noticing this on all the subspecies of *C. lepidus* and on some snakes that would key out to *C. triseriatus aquilus*. I also had a group of *C. t. triseriatus* that seemed to be composed of several distinct entities.

I decided to try and get some electrophoretic data to see if I could get a fix on what I felt I was seeing. I put together a series of specimens of *C. triseriatus* from different areas and also a group of *C. lepidus* representing several known subspecies. I also put in a *C. p. pricei* to make sure, I hoped, would at least give me something different and act as a "control". Through Jerry D. Hardy, Jr. we contacted Ray Morgan at Chesapeake Biological Laboratory at Solomon's, Maryland.

We visited the laboratory in December 1973 and Ray's technician, Martha was setting up the gels for a disc electrophoretic run. The rattlesnakes were tubed, and the underside of the tail was pricked and blood was collected in hematicrit tubes. The hematacrit tubes were then centrifuged in a hematicrit centrifuge. The serum was to be used in this study. Martha then prepared the gels. Ten gels were run for that first series. The proteins were separated on 7% acrylamide gels.

The results were good. The *C. triseriatus* separated out into four distinct subspecies as expected. The one form that was questionable to me, was more similar to *C. lepidus* than to *C. triseriatus*. *C. t. anahuacus, C. t. triseriatus, C. t. armstrongi and C. t. quadrangularis* are distinct subspecies of *C. triseriatus*. *C. aquilus* is a

distinct species, intermediate between *C. triseriatus* and *C. lepidus* although closer to the latter. The *C. p. pricei* was very distinct from the other specimens. Additional specimens were tested and following is a synopsis of the findings.

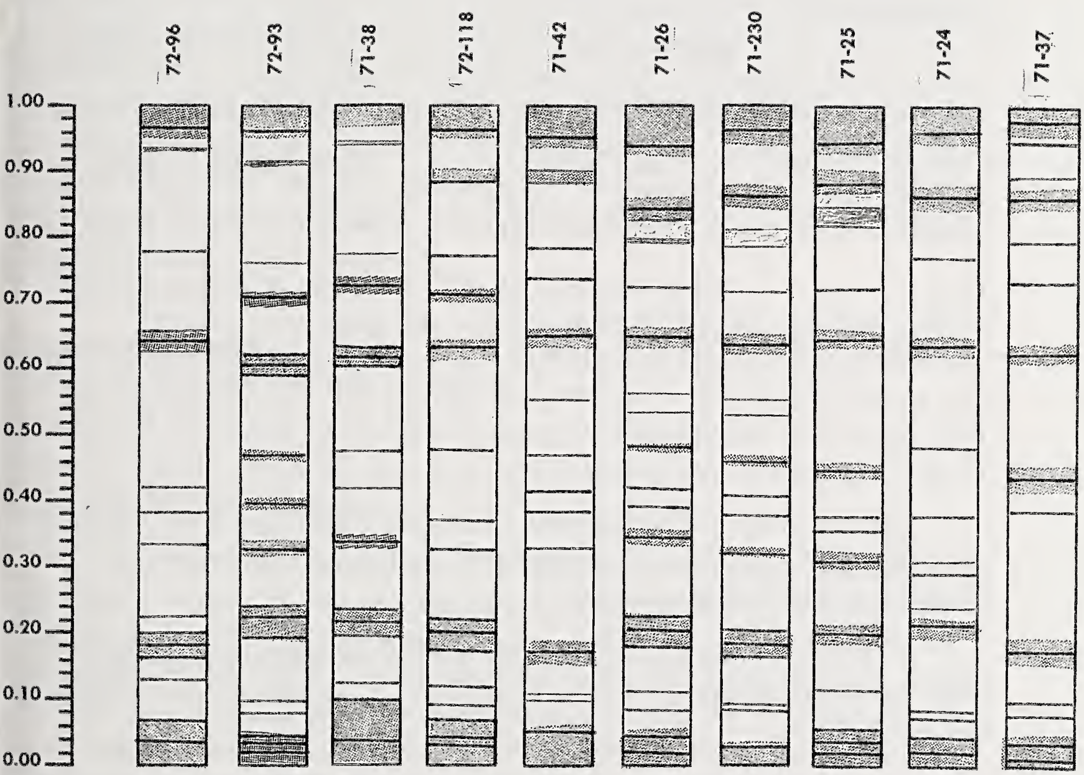

Figure 1. Electropherograms of a select group of Mexican Montane Rattlesnakes. Percent migration can be calculated using the scale at left.

72-96 (RS 1288 HSH).	*Crotalus triseriatus anahuacus.*	Mexico, Morels, Laguna Zempoala.
72-93 (RS 957 HSH).	*Crotalus triseriatus armstrongi.*	Mexico, Jalisco, 2 km N Talpapa.
71-38 (RS 999 HSH).	*Crotalus triseriatus armstrongi.*	Mexico, Jalisco, nr. Talpalpa.
72-118 (RS 1058 HSH).	*Crotalus triseriatus triseriatus.*	Mexico, D.F., on road to Guernavaca
71-42 (RS 1229 HSH).	*Crotalus triseriatus quadrangularis.*	Mexico, Hidalgo, nr. Zimapan.
71-26 (RS 1243 HSH).	*Crotalus aquilus.*	Mexico, D.F., Ixtapalapa.
71-230 (RS 1018 HSH).	*Crotalus aquilus.*	Mexico, Hidalgo, El Chico.
71-25 (RS 784 RSS).	*Crotalus lepidus klauberi.*	Mexico, Zacatecas, S Zacatecas.
71-24	*Crotalus lepidus maculosus.*	Mexico. Durango, nr. La Cuidad.
71-37. (RS 961 HSH).	*Crotalus pricei pricei.*	Arizona, Cochise Co., Chiricahua Mountains, Barefoot Peak.

I ask the lab to give me their reasoning based on their experience. These data will include additional specimens run in that series. The parenthesizes are mine. The following data are from their notes:

71-230 (*C. aquilus*-El Chico, Hidalgo, Mexico) clearly resembles both 71-26 (*C. aquilus*- Ixtapalapa, D.F., Mexico) and 74-25 (*C. aquilus*- El Chico, Hidalgo, Mexico).

The following group exhibits fairly distinct banding pattern 71-42 (Nr. Zimapan, Hidalgo, Mexico), 73-70 (3 mi SW Jacala, Hidalgo, Mexico), 73-71 (3 mi SW Jacala, Hidalgo, Mexico), 73-73 (3 mi. SW Jacala, Hidalgo, Mexico), 75-56 (Rancho Alvarez, San Luis Potosi, Mexico), and 75-57 (Rancho Alvarez, San Luis Potosi). These specimens represent *C. t. quadrangularis.*

71-38 *(C. t. armstrongi*-Talpalpa, Jalisco, Mexico) and 72-93 (*C. t. armstrongi*- 2 mi N Talpalpa, Jalisco, Mexico clearly are the same.

73-66 (*C. l. morulus*-Coahuila Border, due N Cerro Potosi, Nuevo Leon,

Mexico) and 72-68 (C. l. morulus- Mountains SE San Francisco, Tamaulipas, Mexico) very distinct from the rest. It is interesting to note that they felt there was some relationship, however, with 73-69 (*C. t. anahuacus*-Laguna Zempoala, Morelos, Mexico) and 72-96 (*C. t. anahuacus*-Laguna Zempoala, Mexico, Mexico) and much farther away with 71-24 (*C. l. maculosus*- Nr. La Cuidad, Durango, Mexico).

As presented in Harris and Simmons (1978), *Crotalus t. anahuacus* is shown to be a valid subspecies as the protein bands are distinct from those of *C. t. triseriatus* and *C. t. quadrangularis* and. *C. triseriatus armstrongi*. *Crotalus aquilus* is shown to be closer to *Crotalus lepidus* than to *Crotalus triseriatus,* hence the reason it was elevated to specific status. In the *C. lepidus* group shown here, *C. aquilus, C. l. klauberi* and *C. l. maculosus*, the protein bands show less variation than in the *C. triseriatus* group. As indicated on p.126 of Harris and Simmons (1978) *C. triseriatus armstrongi*, of which two individuals are presented, is here shown to be different as to protein bands than either C. *t. triseriatus*, C. *t. anahuacus* or *C. t. quadrangularis* and was in part why I had planned to describe it as *C. t. armstrongi* after the collector who first obtained specimens for me.

I told Barry Armstrong that I would describe the Talpalpa *Crotalus triseriatus* that he collected and name it after him, something I has never done, as it was a new subspecies, and he was to provide additional material. Since I did not describe it in the Harris (1978) paper, apparently J. Campbell was approached. It is a shame that I was not contacted as not only did I have more material, but also specimens from the Mexican State of Michoacan.

Additional specimens that were available at the time of the Campbell (1979) description include: RS 999 HSH/RSS (NHSM)(71-38), collected September 1970, NR. Tapalpa, Jalisco, Mexico at an elevation of 7800 feet, by B. Armstrong and T. Basey, RS 957 HSH/RSS (72-93) collected August 1973, 2 mi N Tapalpa, Jalisco, Mexico by L. Poras R. Robinett and R. McCranie, RS 1000 HSH/RSS (73-67), collected September 1973, about 10 mi N Tapalpa, Jalisco, Mexico at about 7800 feet by Barry Armstrong, RS 1050 HSH/RSS (73-96), collected August 1973 on road between Uruapan and Zancitaro, Michoacan, Mexico by John Rindflesh, RS 1133 HSH/RSS (73-68) collected September 1973 , about 10 mi N Tapalpa, Jalisco, Mexico, at about 7800 feet, by Barry Armstrong, and RS 1161 HSH/RSS (76-4) collected April 1976 at Tapalpa, Jalisco, Mexico, by Louis Porras. All specimens are at the NHSM.

Acknowledgments

I would like to thank the late Dr. Robert S. Simmons, without whom, none of this work would have been accomplished. I would also like to thank Jerry D. Hardy, Jr., Ray Morgan and Martha all formerly of the Chesapeake Biological Laboratory, Solomon's, Maryand. I would also like to thank Robert W. Bryson and Hobart M. Smith for obtaining copies of some pertinent literature for me.

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Are There Hellbenders in the Potomac River?

The hellbender, *Cryptobranchus alleganiensis* (Daudin), is Maryland's largest amphibian. Adults may reach 24 to 28 inches in length, and can weigh several pounds. In Maryland, this aquatic salamander has been reported from the Susquehanna River and several of its tributary streams in Cecil County (Fowler 1915, Fowler 1947), and in the Youghiogheny and Casselman Rivers in Garrett County (McCauley and East 1940, Fowler 1947). The Susquehanna River population has apparently been extirpated, and the status of the Youghiogheny River population is questionable. Hellbenders still occur in the Casselman River. After recommendation by CREARM (1973) and because of its restricted local range and the historic decline of *Cryptobranchus* in this state, the hellbender was listed by the Maryland Department of Natural Resources (DNR) as an Endangered Species, and is fully protected wherever it occurs in Maryland.

Quite a few years ago I visited Robert H. McCauley and had the opportunity to discuss Maryland herpetology with him. At one point in our conversation we touched on the status of *Cryptobranchus* in Maryland, and McCauley showed me a copy of an article from the fishing column of a Berkeley Springs, West Virginia newspaper. The article stated that a local fisherman had caught a Hellbender in the Great Cacapon River (Potomac River drainage) not far west of Berkeley Springs, and indicated that area anglers were familiar with these large salamanders. Accompanying the article was a pretty good photograph of an adult *Cryptobranchus* hanging from a fishing line. Over the years I occasionally thought about that photograph, but did not give it much credence because no other reports came to my attention and there were no published records for this species from the Potomac River drainage (Green 1954, Harris 1975). Still, the photograph provided positive identification of the salamander, so I made a point of asking about hellbenders whenever I spoke with a naturalist or fisheries biologist who was familiar with the Potomac River.

A subsequent discussion with Ed Enamait, a DNR biologist who has conducted fisheries surveys in the middle and upper Potomac, produced the

following information. In late September of 1995, a fisherman caught a large aquatic salamander in the Potomac River near the Route 15 Bridge at Point Of Rocks, Frederick County, Maryland. He brought the creature alive, in an ice chest, to the B&B Grocery Store in Point of Rocks, where Basil Wittacker identified it as a hellbender. A Maryland Natural Resources Police Officer, Robert Taylor, verified Wittacker's identification based on a detailed description. I discussed the incident with both Wittacker and Taylor and am certain that the creature in question was a hellbender, and that it was caught locally. Wittacker told me that the salamander was alive, flat, brown, and about 15 inches long.

So, we have two reports, spaced decades apart, of single hellbenders from a river that flows into the Potomac and the Potomac River itself. Does that mean that an unrecognized population of this large species is present? Only additional survey will answer that question, but the following information is worth considering. When Fowler (1947) reviewed the known distribution of *Cryptobranchus* in this area, he speculated that the hellbender might be found in the Potomac. Fowler cited the encroachment of Potomac headwater streams into the adjacent Youghiogheny drainage as a mechanism for this species gaining entry to the Potomac drainage. Evidence for the transfer of aquatic species from one of these drainages to the other via the capture of headwater tributaries is well documented (Lee 1976, Stauffer et al. 1978, Cincotta et al. 1986), and it is certain that a number of species of fishes have crossed over. Furthermore, in our region the hellbender frequently occurs with another very large aquatic salamander, the mudpuppy (*Necturus maculosus*). The distribution of these two species in the vicinity of western Maryland is similar, and neither is generally considered to range into the Potomac basin (Conant and Collins 1998). However, according to the previously mentioned Berkeley Springs news article regarding the hellbender, fisherman in the Great Cacapon also occasionally catch the mudpuppy, and there actually is a published record for a *Necturus* from the South Branch of the Potomac River near Romney, West Virginia (Green 1954). If the mudpuppy reached the Potomac, why not the Hellbender, since both species inhabit similar large bodies of water?

It is interesting to note that hellbenders did occur in Potomac tributaries during the middle to late Pleistocene. A new species of hellbender (*Cryptobranchus guildayi*) was described from the Cumberland Bone Cave in Allegany County, Maryland by J. Alan Holman (1977). The Bone Cave, on

Wills Mountain near Cumberland, is adjacent to Wills Creek which drains into the Potomac River. Re-evaluation of that taxon has cast doubt on it's distinctiveness, but there is no doubt that the bone represents the remains of a hellbender (Holman 1995). The fauna of the Cumberland Bone Cave is dated to about 300,000 before present (Holman 1995).

Obviously, despite decades of fieldwork by numerous professional and amateur biologists, there are still significant questions to be answered about the local herpetofauna. I would be very interested in talking with anyone who knows of additional records for this interesting aquatic amphibian from the Potomac Drainage.

I would like to thank Ed Enamait for relating this occurrence to me, and Basil Whittaker and Robert Taylor for recalling their experiences. Ed Enamait and Robert Taylor also read and commented on an earlier draft of this note.

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Arnold W. Norden, Maryland Department of Natural Resources, Resource Planning, Tawes State Office Building, Annapolis, MD 21401.

News and Notes

COLBURN, Elizabeth A., The McDonald & Woodward Publishing Company, Ohio, 426 pp. 2004. Vernal Pools: Natural History and Conservation. Available from McDonald & Woodward Publishing Company, Granville, OH, $39.95 Hardcover, ISBN 0-939923-92-0, and Softcover $29.95 ISBN 0-939923-91-2.

The author has provided an excellent overview of vernal pool ecology, including assessment of physical habitats, along with an in-depth summary of the biology and ecology of vernal pool wildlife species.

The first chapter summarizes the geographic distribution of vernal pools in northeastern North America, and provides a comprehensive definition of vernal pools along with providing characteristics that define vernal pools.

Chapters 2 and 3 summarize information on the physical habitat characteristics, while focusing on hydrology and water sources. This is followed by descriptions of the landscape, water chemistry, substrate, surface area and depth of pools. Overall, the chapters provide guidance for conducting inventories of vernal pool habitats, along with restoration or creation of new vernal pools.

Chapters 4 through 10 comprise the bulk of the book and present an excellent review of bacteria, algae, fungi, and protists, along with higher plants associated with vernal pools. They also include detailed species accounts of invertebrates and vertebrate animals associated with vernal pools. The major species of anurans associated with vernal pools are wood frogs (*Rana sylvatica*), green frogs (*Rana clamitans*), bullfrogs (*Rana catesbeiana*), leopard frogs (*Rana pipiens),* western chorus frogs *(Pseudacris triseriata*), spring peepers (*Pseudacris crucifer*), Cope's gray treefrogs *(Hyla chrysoscelis),* gray treefrogs (*Hyla versicolor),* American toads *(Bufo americanus)* and Fowler's toads *(Bufo fowleri*). The major Caudata associated with vernal pools are spotted salamanders (*Ambystoma maculatum*), Jefferson's and Blue-Spotted salamanders, (*Ambystoma jeffersonianum, A. laterale),* and hybrids. Life history data are provided for each of these species including breeding habits, eggs, tadpoles, juveniles and adults, and home range along with information on overwintering. The Chelonian species associated with pools are spotted turtles (*Clemmys guttata*), Blanding's turtles (*Emydoidea blandingii*), painted turtles (*Chrysemys picta marginata*), and snapping turtles (*Chelydra serpentina*) in addition to three species of snakes: common garter snake (*Thamnophis sirtalis*), ribbon snake (*Thamnophis sauritus*) and the northern water snake (*Nerodia sipedon*). Distribution, life history, habitats and home range data are provided for each of the reptilian species except for the three species of snakes.

The author provides 16 excellent color plates showing the dramatic changes that take place within seasons and among years in vernal pools, along with excellent figures of the invertebrates and several species of vertebrates.

The final chapter discusses conservation of vernal pools and associated areas. It discusses factors contributing to the ongoing destruction of vernal pools by filling, drainage, and other activities. Aspects of hydrological alterations, increased water depth during flooding, habitat destruction by development, forest cutting, clearing for agriculture and recreation, mosquito control, pollution, and many other factors are the major causes of destruction of these vital natural areas.

Following the main text is a glossary of technical terms and an appendix listing all animals reported from northeastern vernal pools, along with annotations of their habitats, distributions, and life histories. This is followed by an excellent bibliography of over 800 references and an index which rounds out this excellent book.

The only drawback to the volume is that the author uses numbers which represent citations for literature cited at the end of each chapter, rather than citing the author and date throughout the text.

The author spent more than 25 years studying vernal pools and other small wetland areas, and is a noted authority in the field. She has produced a highly needed volume which should be read by every aquatic biologist, herpetologist and anyone interested in our natural environment. We highly recommend this interesting volume, and also commend the publisher for publishing this awesome book at such a reasonable price, making it readily available to anyone.

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News and Notes

Solorzano, Alejandro, Instituto Nacional de Biodiversidad, INBio, 791 pp. 2004. Serpientes de Costa Rica, Distribution, Taxonomy and Natural History. (Snakes of Costa Rica). Available from Eagle Mountain Publishing, LC, 7705 N. Wyatt Earp Ave., Eagle Mountain, UT 84043, $60.00, Hardcover, ISBN9968-927-00-7.

Within the last two decades we have seen several outstanding volumes on the herpetofauna of Costa Rica, including major works by Skutch (1992), Solorzano (1993), Savage (2002), Beletsky (2004) and Guyer and Donnelly (2005). The first major work was Janzen (1983) covering all aspects of the natural history of Costa Rica, although earlier authors like Taylor (1951, 1954) had published extensive systematic publications on the snake fauna.

Alejandro Solorzano is a Costa Rican herpetologist who has dedicated over 25 years to researching the herpetofauna of his homeland. The author was the founder and director of the National Serpentarium, the first public exhibit in Costa Rica to display the native herpetofauna.

The author recognized 137 species of snakes in 65 genera from Costa Rica from 4 geographical regions which were previously recognized by Savage (1966) and Savage (2002). About 92% of the species are associated with tropical and subtropical regions. Of these 137 species, 22 species are venomous snakes found in Costa Rica. Of the 137 species of snakes found in Costa Rica, 13 species are endemic, while 104 species belong to the Colubridae.

The text is bilingual in both English and Spanish on adjoining pages. Keys are provided for each family prior to the individual species accounts for each specific family. The major portion of the text consists of species accounts which cover some 615 pages, along with some 300 excellent photographs. Each species account provides the scientific name, Spanish name, description, reproduction, habits, diet, abundance, distribution and habitat, along with comments on similar species with which the species possibly could be confused with. An excellent feature is that each species account includes at least one excellent color photograph of each species, and a small distributional map for the species range in Costa Rica.

The author emphasizes that nearly 80% of the primary forests of Costa Rica have been destroyed in the past two decades due to unrestricted human activities, resulting in uncontrolled exploitation of hardwood forests.

Following the species accounts, the author provides information on searching for snakes in Costa Rica and regulations for collecting, removal, or exportation of native species, and areas best suited for observing snakes. This is followed by a highly enlightening account on the history of herpetology in Costa Rica, followed by a short glossary of terms, along with a well researched literature cited section consisting of 507 references, and a taxonomic index.

For those interested in the herpetofauna of Costa Rica or Central America, this book, along with J.M. Savage's (2002) monumental opus on "The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas" will certainly not be just coffee-table books, but you'll spend hours gazing over the wonderful photographs which are different and more enlarged than the former book by Savage. The book has some 300 photographs taken in their natural environment by the author or Michael & Patricia Fogden, with occasional others by several other noted photographers and herpetologists. We would highly recommend figure 25, showing a *Boa* expelling a juvenile deer *(Odocoileus viginianus)*, while fig. 26-29, 37, 62, 101, 224-5, 235 and 187-293 are also all spectacular. Only a few of the rarer species are photographs taken from museum specimens, as the remainder are from specimens in the field.

Other volumes of note are Skutch (1992), Solorzano (1993), Beletsky (2004) and Guyer and Donnelly (2005), all of which cover certain the amphibians and reptiles of Costa Rica, whereas Solorzano's awesome volume is a must for anyone truly interested in the snake fauna, and the Eagle Mountain Publishing Company should be commended for publishing a scholarly, beautiful, affordable book (only $60.00).

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News and Notes

BECK, Daniel D., University of California Press, Berkeley, California. 211 pp. 2005.**Biology of Gila Monsters and Beaded Lizards, with Contributions from Brent E. Martin and Charles H. Lowe. Available from the California Princeton Fulfillment Services, P.O. Box 778-4721, Philadelphia, PA 19182-4721**, Hardcover, ISBN 0-520-24357-9. $49.95.

Immediately upon observing the cover design one will immediately gasp at the awesome figure by Carel Pieter Brest van Kemperi of two male *Heloderma suspectum* in combat, while a female waits in a shelter in the background . This is a once in a lifetime photograph of extremely high quality. Dennis Caldwell produced the skillfull images of 83 individual Gila Monsters and Beaded Lizards from throughout their ranges in Mexico and North America. Tom Wiewandt of Wild Horizons provided the major portion of the 35 photographs illustrating this much needed volume.

This is the first comprehensive treatment of the biology since Charles M. Bogert and Martín del Campo's treatise published in 1956 in the Bulletin of the American Museum of Natural History which has long been a highly collectible volume, having been reprinted by the Society for the Study of Amphibians and Reptiles in 1993, and now also out-of-print.

Ten chapters makeup the contents of this monumental opus, with the first chapter describing Helodermatidae in the slow lane, providing a chronology of some of the history, mythology, and folklore of these intriguing animals, along with its role in Hollywood movies, role in medicine, and a brief review honoring those having laid the foundation on the biology of the helodermatid lizards.

Chapter two describes the evolution, distribution and systematics, along with a distributional map showing the overall range of each of two subspecies of *Heloderma suspectum* and four subspecies of *Heloderma horridum* in Mexico. This is followed by a section on the fossil record, and remarks on the phylogeny.

Chapter three describes the venom system and envenomation along with sections on the chemical makeup and effects of venom, and its ecological and evolutionary role. An overview of human envenomation and case histories of individuals having been bitten by the vice grip known for *Heloderma* is also provided. The important thing is that we know very little about the protein enzymes of *Heloderma* venom, except that they show promise in treating Alzheimer's disease and attention deficit/hyperactivity disorder, and many of these bioactive peptides may prove useful in medicine.

News and Notes

Chapter four on Physiological Ecology opens with a unique essay regarding Takeur Kobayashi who broke the world hot dog-eating record. "Kobayahi engulfed some 50.5 franks in 12 minutes, and he only weighed 113 lb at the start of the contest and 129 lb at the end, having eaten 16 lbs of food, equivalent of 14% of his body mass. The author watched a 640 gram Gila Monster in the summer of 1983 devour four new-born cottontail rabbits, together weighing 210 g., equivalent to 33% of its body mass." The author goes on to explain that a Gila Monster meal would sustain it for nearly 4 months, whereas Kobayahi's meal only 4 days. The amazing energy efficiency of ectothermic vertebrates is fully described. Other aspects discussed are thermal biology, activity temperatures, basking behavior, body temperatures when at rest, energetics, metabolic rates, effects of temperature on metabolic rate, cost of locomotion, energy budgets, assimilation efficiency, fat storage and drinking and water loss rates.

Chapter 5 covers habitat use and activity patterns, with emphases on habitat use, and information on precipitation ranges, vegetation and microhabitat use. This is followed by sections on home range variation in populations, orientation of shelter entrance on a seasonal pattern, orientation, seasonal activity pattern from different environments and dispersal from shelters. The author also discusses habitat use and activity patterns, describing the different habitat types for *H. horridum* and *H. suspectum* followed by information on micro habitat use, home range and dispersion of shelters, timing of activity, home range, the role of shelters, and an encounter with a Gila Monster crawling into his sleeping bag in Sonora, Mexico. You must read this fact full volume on our only venomous lizard, as it is filled with scientific facts in detail, along with many enlightening stories relating to the author's encounters with this awesome creature.

Chapter six is a chapter co-authored by Beck, Martin and the late Charles H. Lowe on population ecology. It starts with an emphasis on body size, as this is a vital factor affecting all traits of an organism. The authors provide information on the maximum size, size classes and population structure, growth rate, sex ratio, longevity, predation and population density. *Heloderma* reaches sexual maturity in 2-3 years, with a fecundity of an average of 6 eggs every 1-2 years, and a longevity record of 20 years or more.

In Chapter seven diet, feeding behavior, and foraging ecology are fully discussed, while chapter eight covers aspects of reproduction, behavior, and *Heloderma* in captivity. Special subjects include sexual dimorphism, reproductive cycles in both male and females, finding mates, mating behavior, combat, courtship and mating,

eggs and oviposition, hatching and hatchlings.

Chapter nine gives a very comprehensive account on conservation of *Helodermatidae*. Habitat loss and alteration of the environment have been major threats, with fragmentation and degradation of suitable habitat as the major culprits. The author gives a good example by stating "St. George, Washington County, Utah saw its population increase nearly 438%, from 11,350 people in 1980 to 49,663 in 2000. The area formally surrounding St. George was prime Gila Monster habitat", but has nearly been completely destroyed by housing development. Arizona is also experiencing rapid growth, and Gila Monsters are being displaced, or killed. Even though Gila Monsters are a protected species, people continue to be a threat in the wanton killing of Gila and Beaded Lizards. Poaching and illegal trade still occurs in both Mexico and Arizona but fines may exceed $10,000, plus restitution expenses.

Both species of helodermatid lizards receive full legal protection from collecting, killing, and transport throughout their ranges.

The final chapter emphasizes the importance of protecting habitats while they still exist. The author recommends additional morphometric studies of the family Helodermatidae, along with additional work on the functional histology of the venom gland and mechanism of venom production, physiological ecology, habitat use and activity, food habits and reproduction with emphasis on the nesting biology of helodermatids.

The book ends with a literature cited section consisting of 492 references and an index.

This book certainly is a must for anyone interested in arid environmental species, and especially those involved in lizard ecology. The author provides a very comprehensive coverage of all the literature known on these two beautiful species, which is related in an extremely readable volume with highly enlightening details and facts. This book will hold your interest from the moment you pick it up! We highly recommend it and feel that every herpetologist will want a copy of this opus on our only poisonous lizards.

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News and Notes

GIBBONS, Whit and Mike DORCAS. SNAKES OF THE SOUTHEAST. 2005. University of Georgia Press, Athens. $29.95. ISBN 0-8203-2652-6.

This colorful book is designed more for the lay person, although the book is also filled with facts on natural history.

The book is divided into four sections – with the opening section giving a brief review of the general biology of snakes, snake diversity, food and feeding behavior, predation, defensive behavior, locomotion, activity pattern, thermal biology, color patterns, recognizing venomous snakes from harmless, and other morphological features. The authors have added interesting "did you know?" inserts in the margins that are filled with facts that the average person would immediately ask if talking with someone about these fascinating creatures. Each chapter is filled with awesome photographs showing morphological features, feeding behavior, defense, and reproduction.

The second chapter consists of 181 pages on species accounts of the 52 native southeastern snakes separated into sections according to size, followed by the two introduced species *Ramphotyphlops braminus* (Brahminy Blind Snake) and Burmese Python (*Python molurus bivittatus*).

Each species account gives a short description giving coloration variation along with morphological cues and comments on intergradation. This is followed by comments on neonates, distribution and habitat, behavior and activity pattern, diet, reproduction, predators, defense and conservation. Each species is represented by more than one excellent color illustration, followed by beautiful distributional maps showing the general range of the species.

Chapter three on People and Snakes gives a short description of what is a herpetologist, why do herpetologists study snakes, and how do herpetologists study snakes? It shows excellent photographs of the effective method for inserting pit tags and implanting transmitters. It also provides a brief description of what rules herpetologists must follow to study snakes, and comments and photographs of common backyard snakes. These are species that are most frequently observed in your yard if suitable habitat is provided. This is followed by a short section on snakes as pets, conservation, threats to snakes, conservation laws, and public education as a means of getting people to understand the importance of snakes as a natural part of our ecosystem.

The closing section gives a table showing what kinds of snakes are found in

your state, if you live in Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, Virginia or Tennessee, and maps showing the distributions of venomous snakes, and another on the number of species that can be found in specific sections throughout the south. This is followed by a short glossary of terms and 24 books that would be of interest for additional reading, and acknowledgments and a short index.

This book certainly will be a treasure to anyone having an interesting in becoming a herpetologist, and any child having an inclination for learning more about these fabulous creatures, especially those curious about snakes in general of the southeastern United States. The photographs will attract every herpetologist, as they are fit in perfect context, and mostly never seen in publications before. Certainly the price will make it highly affordable for both the novice and professional herpetologist.

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AMPHIBIANS & REPTILES OF THE BAY ISLANDS AND CAYOS COCHINOS, HONDURAS. By James R. McCranie, Larry David Wilson & Gunther Köhler, 2005. xiii, 210 pp. Bibliomania, P. O. Box 58355, Salt Lake City, Utah 84158. ISBN 1-932871-07-1. H.C. $29.95.

This book will immediately catch the eye of anyone having seen this attractive volume with a photograph of *Boa constrictor, Hyla microcephala, Kinosternon leucostomum* and *Ctenosaura bakeri* on the front cover and *Ctenosaura oedirhina* on the back cover design. The end pages feature a striking photograph of *Micrrus ruatanus* from Isla de Rotatán. The entire book is loaded with exceptional photographs of each of the 55 species found within the Bay Islands and Cayos Cochinos of Honduras.

The authors give a detailed description of the Bay Islands and Cayos Cochinos physiography and each of the individual islands Isla de Utila, Isla de Rotatán, Isla de Guanaja, which are illustrated with awesome photographs of the locations of each individual island along with habitat illustrations. This is followed by details on the climate, habitats and a lengthy historical sketch of the history of both the Bay Islands and Cayos Cochinos, and a section on the Social History of the Bay Islands and Cayos Chochinos. The photographs consist of highly attractive photos of deforested areas of Isla de Roatán, hardwood forest of Cayo Cochina Pequeño and Isla de Utila, along with mangrove forest near Rock Harbor and Isla de Utila. Additional photographs exhibit the coconut palm habitat of Isla de Barbarera, Iron Bound, and Isla de Utila, and are accompanied by other awesome photographs of sea grape trees, beach vegetation, temporary swampy area, marine and urban areas from French Harbor, Isla de Roatán. Humans have occupied the Bay Islands and Cayos Cochinos since pre-Colombian times, whereas the period of conquest and colonization of Bay Islands by Europeans began during the period of Columbus' landing on Guanaja in late 1502.

The composition of the herpetofauna from each of the individual islands is given in the following 5 pages, which consists of 55 species having thus far been collected. This is followed by illustrated keys for species of the herpetofauna, with remarks on the current common names in both English and Spanish, descriptions along with excellent color photographs, remarks on similar species, general geographical distribution and distribution on specific islands, along with natural history comments on habitat and activity pattern for each species.

The section on ecological distribution and relationships of the herpetofauna of the Bay Islands and Cayos Cochinos are divided into nine major habitat types (i.e.,

hardwood forest, pine forest, mangrove forest, coconut groves, ironshore formations, swamps and marshes, estuaries, marine environments and urban settings). The authors have shown the distribution of the herpetofauna in the different habitat types for each of the 56 species, along with tables showing a coefficient of habitat resemblance matrix for each of the islands, showing the number of species found on each island. The authors show a high level of endemism for the Islas de la Bahía.

Following the biogeographical summary the authors discuss the conservation status of the herpetofauna of the Bay Islands and Cayos Chochinos. Islands are known as centers of endemism in most cases, and the authors give a brief summary of the five natural mass extinction episodes that have occurred, although the major episode is the mass destruction by humans. The authors felt that this episode occurred at the same time that species diversity had reached an all time high. The authors have recognized three categories for classifying the herpetofauna. These are low vulnerability, which consists of wide ranging species, medium vulnerability and highly vulnerable species. This is followed by a discussion of the conservation efforts on both the Bay Islands and Cayos Cochinos and the outlook for the future of the herpetofauna.

This book is rounded out by a glossary of terms and 139 references cited. Of the 139 references cited, 31 are from the author's pen. This is followed by an index of scientific names.

Both the authors and publisher should be highly commended for producing such a beautifully illustrated and needed work on the Honduran herpetofauna. This book should be on the bookshelves of anyone interested in the herpetofauna for both Central and South America, along with all major libraries.

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News and Notes

AMPHIBIANS AND REPTILES: STATUS AND CONSERVATION IN FLORIDA. By Walter E. Meshaka, Jr. and Kimberly J. Babbitt (eds.) 2005. xv +317 pp. Krieger Publishing Company, Malabar, Florida 32950. ISBN 1-57524-251-6. Cloth. $66.50.

It is well known that Florida contains more exotic amphibians and reptiles than any other state because of its diverse habitats and mild climate throughout the year, whereas Arizona probably runs a close second. The present volume consists of 27 contributions by such noted herpetologists as Ray E. Ashton, Jr., C. Kenneth Dodd, Kevin M. Enge, Jr., Richard D. Franz, D. Bruce Means, Henry R. Mushinsky and the editors, to mention only a few.

The book opens with a list of figures, tables and contributors, along with a brief introduction. This is followed by a short article by R. Ashton, Jr. on the Florida herpetofauna in a changing environment, with a table listing the 63 species of amphibians and 128 species of reptiles of Florida, in addition to maps showing the number of species from each family found within the state.

Part II consists of 11 chapters on such topics as habitat loss, alterations, and fragmentation and the Florida herpetofauna. It covers such aspects as human disturbance of Florida anurans, the effects of herpetofauna of impacted wetlands in East Florida, effects of roads on the herpetofauna, impact of pesticides, impact of agriculture on temporary wetlands; effects of sand pine silviculture on pond-breeding amphibians, natural history and status of the Flatwoods Salamander (*Ambystoma cingulatum*); the value of dead tree bases and stumpholes as habitat for wildlife, the role of isolated ephemeral wetlands on amphibian populations in xeric sand hills, and conservation of the life history of the Striped Newt (*Notophthalmus perstriatus*).

Chapters 12 and 13 concern the conservation of the Eastern Box Turtle (*Terrapene carolina carolina*) by Dodd & Griffey and Ray Ashton respectively, covering box turtles on public lands and a case study of the box turtle on Egmont Key, and information on the development of a management program for both *Terrapene carolina* and the Gopher Tortoise (*Gopherus polyphemus*) in Florida.

Chapters 14 and 15 give a glimpse into the life history of the Florida Pine Snake (*Pituophis melanoleucus*) using radio-transmitters, with comments on movement pattern, home range, habitat use, activity pattern, movement, arboreal behavior, shelters, shedding cycle, and other characteristics of this snake in the sandhill area of northern Florida. Chapter 15, by Krysko and Smith, comments on the decline and

extirpation of *Lampropeltis getula* throughout its range in Florida.

Chapters 16 and 17 include two short essays covering wetland species with an emphasis on the status of the American Alligator (*Alligator mississippiensis*) in Southern Florida and its role in measuring restoration success in the Everglades. They also focus on the relationships among habitat type, hydrology, predator composition, and distribution of larval anurans in the Everglades.

Chapter 18 is brief, covering 5 pages on the threats to Florida rivers and turtles populations caused by exploitation for food, the pet trade, and degradation of habitat.

Chapters 19 and 20 cover estuarine systems, with chapter 19 covering insular ecology of the Florida Keys with emphases on the Mangrove Salt Marsh Snake (*Nerodia clarkii compressicauda)* and Eastern Diamondback Rattlesnake (*Crotalus adamanteus*). There is a discussion of data collected from both species with importance to microbial ecology, with considerable information on the blood biochemistry and microbial organisms specific to these species. The authors found four distinct phenotypic color patterns in the Mangrove watersnake (*Nerodia c. compressicauda)*, which is unusual in snake species. Chapter 20 is a review of information on the Diamondback Terrapin (*Malaclemys terrapin* and its subspecies). The Diamondback is the only species of estuarine emydid turtle found in North America, and has suffered drastically from the popularity of this turtle as a gourmet food item. Its low reproductive rate and high nest mortality has also hindered the comeback of this species. Predation by animals (e.g., raccoons), motorboating, and the crabbing industry have also contributed to the decline of this species.

Parts 4 and 5 consist of three chapters (21-23) on the commercial harvesting of alligators in Florida, commercial harvesting of amphibians and reptiles for the pet trade, and commercial trade of rattlesnakes with emphasis on the Eastern diamondback and Timber rattlesnakes. These three chapters are essential as they show man's impact on our precious herpetofauna. This is followed by chapters 24 and 25 on exotic species, with emphysis on the Knight anole (*Anolis equestris)* and several species of hemidactyline geckos (*Hemidactylus frenatus, H. garnotii, H. mabouia* and *H. turcicus*).

This book provides a wonderful synthesis of the effects of an "ever-worsening collison of human activity", and its effect on the fauna of Florida.

The appendix supplies county records of native amphibian and reptile spe-

cies found in Florida, followed by an extensive index of over 900 references.

This book is a important reading for anyone interested in conservation, and especially those concerned about our present governmental practice of destroying our environment for personal monetary greed!. It ia also a must for any library interested in the herpetofauna of North America, and especially those patronized by persons conducting any environmental study, and those in the southeastern United States.

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News and Notes

AMPHIBIAN DECLINES: THE CONSERVATION STATUS OF UNITED STATES SPECIES. By Michael Lannoo (ed.), 2005. xxi + 1094 pp. University of California Press, Berkeley 94704. Available from California Princeton Fulfillment Services. ISBN-520-23592-4. Cloth. $95.00.

This monographic volume is the second volume edited by Michael Lannoo on the conservation of our precious amphibian fauna which has been drastically altered in the past two decades from various factors, some of which are unknown. It is known that habitat destruction by agriculture, urban development, timber harvest/s silviculture, livestock grazing, altered fire regime, recreational land use or development, road construction, mining and pesticide overuse have been major factors, while ultraviolet radiation, water source manipulation, diseases, exotic species introductions, chemical contamination, collecting/harvesting, and acid rain have all been contributing factors. Many other factors may also possibly be culprits. The first volume "Status & Conservation of Midwestern Amphibians," edited by Mike Lannoo, was published in 1998 by the University of Iowa Press. Both these volumes will certainly stand as a landmark for the conservation of amphibian species within North America.

The present volume consists of 52 essays and other articles relating to population decline causes, conservation politics and the need for protection of our native fauna. Also included are sections on methods for monitoring and surveying populations, and the education of the government and people about the drastic need for assistance in protecting our native fauna. This is followed by a lengthy section on species accounts for all species of special concern by a number of authors.

Part two covers the species accounts for all the known species of amphibians found within the boundary of the United States. Previously, no detailed account for all of the known species existed, and those that did were incomplete. The introduction to the species accounts was written by M. Lannoo, A.L. Gallant, P. Nanjappa, Laura Blackburn and R. Hendricks, and the present species accounts were written by experts on each species or reviewed by experts on each species. All the accounts are backed by references to the scientific literature, unpublished data, or personal communications. It is hoped that these accounts will serve as a foundation for others to continue further research in much needed areas not covered by the distributional maps and stimulate future research on specific areas not covered in the present species accounts.

The authors follow Crother et al. (2000,2003) listing of species with the following exceptions: (1) they recognize the existence of silvery salamanders (*Am-*

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bystoma platineum) and Tremblay's salamander (*A. tremblayi*), along with recognizing the unisexual *Ambystoma* hybrids. They also recognize the Arizona toad (*Bufo microscaphus*) and California toad (*B. californicus*) as separate species. *Rana draytonii* and *Rana aurora* are considered separate species, and they also acknowledge the existence of dark-sided salamanders (*Eurycea aquatica)* in Georgia. Both the black dart-poison frogs *(Dendrobates auratus*) and the Martinuque greenhouse frog (*Eleutherodactylus martinicensis)* are established in Hawaii, along with several not yet described species of *Eurycea* and a *Necturus* as yet not described from the mainland.

The species accounts consist of 532 pages, consisting of nearly half the text. The accounts cover all the known species of amphibians found within the United States. Each species account opens with an introduction describing the methods and ecoregions, along with maps showing the amphibian species richness at the family level, the richness of introduced species, species with terrestrial eggs, species with aquatic eggs, larval and adult stages, species that develop in water and breed in standing water, species that reproduce in flowing water, endangered species and species of special concern within the United States. This is followed by a comprehensive list of species including current specific names, and common names, and appendies on species with terrestrial eggs, species that exhibit some form of parental care or communal nesting, genera or species with aquatic eggs, larval and adult life-history, species that breed in seeps, springs or small streams, species found in caves, and a list of federally listed species. Each of the individual species accounts provides the family, scientific name, and common name followed by comments on the systematic status, historical and current distribution, historical versus current abundance, life history notes on breeding, eggs, larvae/metamorphosis, juvenile habitat, adult habitat, aestivation/avoiding desiccation when known, seasonal migration, interspecific associations, age/size at reproductive maturity, longevity, feeding behavior, predators, antipredator mechanisms, diseases when known, conservation and parasites of the organism. An excellent distributional map showing the overall range of the species is also provided for each species.

The species accounts are followed by an epilogue compiled by David F. Bradford of the USEPA National Exposure Research Laboratory in Las Vegas, Nevada and devoted environmental advocate on the factors implicated in amphibian declines in the United States. He compiled the factors implicated that adversely affected populations and assessed the status of each of the species with regard to the stability of its distribution and population number.

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The author reviewed drafts for each of the 267 species accounts available for the actual 103 anurans and 186 caudates covered in this massive volume. The author then concluded that (81%) of the 91 native anurans considered and 108 (61%) of the 176 native caudates were adversely affected by population declines, and only (5%) of the anurans and no caudates increased in ranges. A table is provided for each family of anurans and caudates, species of both anurans and caudates, showing major decline, net extirpation, no change, increase or not determined, along with figures showing graphic illustrations covering regional distribution of status frequency for native species, frequency of *Rana* species versus non-*Rana* considered at net extirpations or major declines of species for western versus non-western United States species, factors implicated for population declines, such as land use, exotic species, chemicals, disease, water source, harvesting, UV -B and other, major land use factors affecting persistence of populations, exotic taxa implicated as affecting persistence of populations, and frequency of factors implicated as affecting persistence of populations in the western versus non-western United States.

This is followed by a massive 148 page comprehensive literature cited section, along with a highly useful index.

We would certainly recommend this book for every library in the continental United States, as the cover will certainly attract even those laymen having only seen scattered newsprint articles regarding amphibian population declines, and possibly stimulate more people to become aware of what is happening to our environment.

Every herpetologist will certainly want this volume on his or her bookshelf as the most valuable volume yet available on our amphibian fauna. The editor and contributors should be commended for this massive project, along with the publishers in taking over this project and producing such an excellent volume.

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News and Notes

IGUANAS: BIOLOGY AND CONSERVATION. By Allison C. Alberts, Ronald L. Carter, William K. Hayes and Emília P. Martins (eds.), 2004. xvi + 356 pp. University of California Press, Berkeley, California 94704. ISBN0-520-23854-0. Cloth. $65.00.

This outstanding book consists of twenty essays by the editors, along with distinguished behaviorists Gordon M. Burghardt, Ahrash N. Bissell, Jesús A. Rivas, Luis E. Levín, Rartin Wikelski, and John B. Iverson. The text is divided into three parts covering diversity, behavior and ecology and conservation.

The present book stems from a 1997 symposium in Seattle, Washington on which the present volume is based. The symposium was held exactly fifteen years after the publication of *Iguanas of the World: Their Behavior, Ecology, and Conservation*, which was edited by A. Stanley Rand and Gordon M. Burghardt. Gordon was honored in writing the introductory chapter entitled "Looking back and looking ahead," in the present volume. The author gives a thorough excellent review of research on the Iguanas, naming such excellent researchers as L.T. Evans, G.K. Noble, C.C. Carpenter, I. Eibl-Eibesfeldt, D. Werner, C. Carpenter, G. Rodda and S. Rand, to mention a few outstanding ethologists, along with comments on his findings on nesting behavior. The author also lists topics that he thinks are of considerable interest and important for future studies.

Part one opens with a short introduction on biological diversity, with five chapters viewing biodiversity at different levels. Four of these five focus on igauna systematics, along with an overview on Iguanidae.

The opening chapter by Hollingsworth gives an enlightening overview of morphological and molecular studies having taken place, with emphases on the genetic relationships within *Sauromalus, Ctenosaura,* and *Cyclura*. The author provides an excellent checklist of the eleven genera and forty-four species. This number can be attributed to the description of three extinct monotypic genera, along with the elevation of subspecies to species. The checklist provides a listing of synonyms for each presently used name in chronological order. The author feels that further DNA sequencing is necessary to resolve the interspecific relationship with the genus *Sauromalus,* and *Cyclura* is in need of a revision.

The third chapter by Malone and Davis on the Caribbean genetics and conservation provides a table showing the impact of taxa extinction on the genetic diversity of the genus. The authors discuss genetic tools of importance in improving our

understanding of population variations, and feels that additional DNA studies are needed in examining present taxonomic arrangement for setting conservation priorities.

Chapter four by Welch, Gerber and Davis discusses the genetic structure of the Turks and Caicos rock iguana and its implications for the species conservation. The iguana *Cyclura carinata carinata* reaches high density on many islands having little impact by man. The genus is noted for having a high level of endemism, with sixteen subspecies recognized from a single island or island groups in the Greater Antilles.

Chapter five traces the evolution of the Galápagos iguanas, which consists of two genera. The Galápagos land iguana (*Conolophus*) and the marine iguana (*Amblyrhynchus)* are the only genera found on the Galápagos archipelago. Mitochondrial DNA (mtDNA) sequence analyses show a sister taxon relationship between the two genera, but suggested a separation time of greater than 10 Ma. The authors feel that the land and marine iguanas must have evolved on former, now sunken islands of the archipelago.

Chapter six provides an excellent insight into sodium and potassium excretion in Iguanidae, although the author provides a table showing the distribution of the salt glands in all families of lizards, with emphasis on the iguanids.

Part two on behavior and ecology consists of a short introduction by Emilia P. Martins followed by six chapters on behavior ecology. Chapter seven on behavior and ecology of rock iguanas by Martins and Lacy is rather short and discusses the appeasement display, with emphasis on *Cyclura carinata* on eight islands in and near Providenciales, in the Turks and Caicos Islands, with emphasis on headbob behavior in aggressive posture, or submissive behavior. Chapter eight by Bissell and Martins found that populations of *C. carinata* on Chalk Sound and two adjacent small islands had substantial differences in body size, number of neighbors within study sites, and headbobbing behavior. Other behavioral and morphological factors may be of significance, although the authors feel that display behavior possibly evolved in response to habitat conditions.

Chapter nine on sexually dimorphic antipredator behavior in juvenile green iguanas by Rivas and Levin is concerned with kin selection in the form of fraternal care, whereas chapter ten covers lek mating success in male Galápagos marine iguanas in relation to behavior, body size, ornamentation, ectoparasite load and female choice. This chapter is by William K. Hayes et al. and goes hand-in-hand with chap-

ter 11 on environmental scaling of body size in island populations of Galápagos marine iguanas by Martin Wikelsi and Chris Carbone.

Chapter 12 focuses on environmental influences on body size of *Sauromalus obesus* and *Dipsosaurus dorsalis,* two herbivorous desert lizards from the southwestern United States. The remaining chapter in the behavior and ecology section is on factors affecting long-term growth of the Allen Cays rock iguana in the Bahamas by John B. Iverson, G.R. Smith and L. Piper.

The remaining portion on Conservation opens with a short introduction providing statistics on the extant lizards attaining an adult body mass greater than 1 kg, e.g., "large lizards represent over two-thirds of the lizard species classified as critically endangered." Over thirty-five living species of large herbivorous lizards belong to the family Iguanidae, and are the most endangered lizards in the world. The author feels that this can be attributed to the large proportion of the iguanas inhabiting islands. The South Pacific species belonging to the genus *Brachylophus*, all rock iguanas (*Cyclura)*, and *Sauromalus varius* are presently provided the highest degree of protection. The genera *Amblyrhynchus, Conolophus*, as well as green and Lesser Antillean iguanas (*Iguana*) are also listed under CITES ruling.

Chapter 14 on translocation strategies as a conservation tool for West Indian iguanas by Knapp and Hudson is extremely interesting, but certainly will draw considerable flack from some conservation biologists. The authors feel the multiple releases are necessary for the success of the Jamaican iguana (*Cyclura collei*), the Anegada iguana (*C. pinguis*), and the Grand Cayman iguana (*C. Nubila lewisi*). The authors provide information on former past translocations, along with comments on controlling introduced predators, and provide information that is needed prior to translocating species. This program could possibly be the only program available for insular population success, and the West Indian iguana translocations to date appear to be successful. Chapter 15 goes hand-in-hand with the former chapter as it discusses testing the utility of headstarting as a conservation strategy for West Indian iguanas.

Chapter 16 by Wilson et al. on survival and reproduction of Jamaican iguanas provides an overview of the Jamaican iguana headstart-release program.

Chapter 17 by Hayes et al. and chapter 18 by Carter and Hayes synthesize over eight years of field work on the endangered Salvador rock iguana (*Cyclura rileyi)* along with a summary on the annual conservation research activities on three subspecies of *C. rileyi*. The authors recommend further research to obtain basic bio-

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logical knowledge for effective management, eradication of invasive species, habitat restoration and suitable nesting habitats.

The final two chapters on the role of zoos in the conservation of West Indian iguanas by Hudson and Alberts discusses the slow response in responding to pleas for help in breeding programs for the eighteen taxa that represent the most highly endangered lizards of the world, and Knapp's ecotourism and its potential impact on iguana conservation in the Caribbean, and a lengthy literature cited section and index round out this much needed book which will serve to spotlight the conservation program in the minds of people throughout the world, and encourage our government to provide the necessary funding for future research on the natural history and conservation of our dwindling flora and fauna.

The editors and publishers should certainly be commended for publishing this badly needed volume promoting our attention to the iguana biology and conservation effort.

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News and Notes

KENTUCKY SNAKES: THEIR IDENTIFICATION, VARIATION AND DISTRIBUTION. By Les E. Meade, 2005. xiv + 323 pp. + 17 unnumbered pages of color plates. Kentucky State Nature Preserves Commission. Limited to 100 copies.

This definitive work will stand out as the most valuable contribution to the herpetology of Kentucky ever published. The author does not intend this monograph on Kentucky snakes as a field guide, but rather a work that summarizes all the known information on snake taxonomy, identification, variation and distribution in Kentucky.

This awesome volume provides an excellent overview on the serpents of Kentucky, as the last comprehensive volume was by Roger W. Barbour, "Amphibians and Reptiles of Kentucky," published in 1971 by the University of Kentucky Press. A recent pamphlet on "Kentucky Snakes," was compiled by Bill Moore and Tim Slone, and published by the Kentucky Department of Fish and Widlife Resources in 2002.

The book opens with a preface, list of acknowledgments, and introduction giving a brief summary of sense organs, feeding, locomotion, classification, sexual dimorphism, and external anatomy of snakes. This is followed by excellent drawings showing key characteristics used in species identification.

The author provides an excellent literature review of outstanding naturalists and herpetologists having made major contributions on the ophidia of Kentucky, followed by a checklist and key to the species and subspecies of Kentucky snakes.

Each species account includes sections on taxonomy, etymology, identification, description, variation, distribution in Kentucky, biology and conservation status. Distributional maps and b/w photographic plates for each of the 42 species and subspecies of snakes follow each description, and excellent color plates of each species can be found on the 17 pages of unnumbered pages at the end of the text. The description for each species and subspecies contains information about size and proportions, scutellation, coloration, and hemipenal morphology. The distributional maps were plotted by using collection data from literature and museum records. The biology section includes information on diet, behavior, habitat, reproduction and unusual traits, if appropriate.

A unique feature is that the author has cited museum numbers for all specimens of each Kentucky species or subspecies examined, which will make this vol-

ume a valuable tool for those working on species accounts for the Catalogue of American Amphibians and Reptiles.

This monograph is an awesome contribution supplementing what is known regarding the herpetofauna of Kentucky. The volume is 8 x 11", spiral bound although an extremely attractive volume. A brief literature cited section on all known references referring to Kentucky snakes is followed by appendix A describing the physiographic regions found within the state of Kentucky. Six major physiographic regions are recognized within Kentucky, and include the Cumberland Plateau, Cumberland Mountains, Bluegrass, Mississippian Plateau, Western Coal Fields and Jackson Purchase.

Appendix B provides a glossary of terms, followed by colored plates rounding out this highly useful volume.

The author and publishers should be commended on producing such a useful πand much needed volume on the snakes of Kentucky.

It certainly is a shame that only 100 copies of this magnificent book were available, as most major museum and University libraries and only a select few individuals will even see or own this excellent monograph.

Literature Cited:

Barbour, Roger W.
1971. Amphibians and Reptiles of Kentucky. Univ. of Kentucky Press, Lexington.

Moore, Bill and Tim Slone.
2002. Kentucky Snakes. Kentucky Dept. Fish and Wildl. Resources, Lexington.

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News and Notes

Society Publication

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Major papers are those over five pages (double spaced, elite type) and must include an abstract. The authors name should be centered under the title, and the address is to follow the Literature Cited. Minor papers are those papers with fewer than five pages. Author's name is to be placed at end of paper (see recent issue). For additional information see *Style Manual for Biological Journals* (1964), American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

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THE NATURAL HISTORY SOCIETY OF MARYLAND, INC.

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Volume 42 Number 2 June 2006

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Volume 42 Number 2 June 2006

Variation in the Crevice Spiny Lizard, *Sceloporus poinsettii* Baird and Girard

Robert G. Webb

Abstract

This report updates information on variation and distribution of the Crevice Spiny Lizard, *Sceloporus poinsettii* Baird and Girard. Five intergrading subspecies of *S. poinsettii* (scalation and pattern features) are recognized (two described as new). The holotype of *S. poinsettii polylepis* is regarded as a morphological variant or intergrade; the name *polylepis* is reassigned to a distinctive population that lacks any other name. This large, rock-dwelling lizard of the *S. torquatus* species-group occurs generally in the southwestern United States and northern Mexico.

The initial discovery of some smallish *Sceloporus poinsettii*-like lizards in northeastern Zacatecas in 1975 and from other nearby localities in later years (and their uncertain identification over the past several years) prompted study of *S. poinsettii* to determine the extent of variation throughout its geographic range. Familiarity with *S. poinsettii*, both in the field at various locales and from examination of museum specimens, has provided some insight into character trends and geographically recognizable populations. Smith ("1936"[1938], 1939) provided a working definition of the then monotypic species. Smith and Chrapliwy (1958) described two subspecies, *S. p. macrolepis* and *S. p. polylepis*, both recognized in this report. Tanner (1987) described *S. p. robisoni*, which is not here recognized (see Remarks, *S. p. macrolepis*). Auth et al. (2000), following the lead of Olson (1998), used name-combinations reflecting conspecificity of *S. poinsettii* and *S. mucronatus*; Olson's material and specimens subsequently studied from the states of Hidalgo and Mexico were assigned to *S. mucronatus* (Webb et al., 2002; Bell et al, 2003:146).

Specimens with small dorsal scales in the eastern desert parts of Durango, Chihuahua (including holotype of *S. p. polylepis* as well as other near topotypic specimens), and adjacent Coahuila have been referred to *polylepis* for many years, but their collective variant array of patterns (with some not unlike those of the adjacent Texas subspecies) has contributed to a festering, unsatisfactory concept of the taxon *polylepis*. The holotype of *S. p. polylepis* has small dorsal scales (41-42, *polylepis*) but a rear-of-head pattern with a black cruciform blotch (characteristic of Texas subspecies) and is regarded as an intermediate morphological variant. Specimens previously assigned to *S. p. polylepis* are now regarded as variants or intergrades. This revelation of regarding the holotype of *S. poinsettii polylepis* as part of a large intergrading population (Fig. 11) requires inquiry into the status of the name *polylepis*.

The Code (ICZN, 1999) declares that [Art. 23.8] "A species-group name established for an animal later found to be a hybrid must not be used as the valid name for either of the parental species." Unfortunately, Art. 23.8 (and the Code otherwise) seems

not to deal with intergrades between subspecies (although using "species-group name"). Rather than clutter the literature with a new name, stability and continued use of *polylepis* (since 1958) as a valid name is maintained.

The small *S. poinsettii*-like lizards (discovered in Zacatecas in 1975, mentioned above), with geographical integrity and consistent morphological features, also have small dorsal scales and are considered the genetic donor of small dorsal scales that currently characterize specimens assigned to *S. p. polylepis*; also, the consistent, black rear-of-head with whitish markings occurs in some specimens currently passing as *polylepis*. These small-sized and small-scaled *S. poinsettii*-like lizards are described as *S. poinsettii polylepis*.

This non-phylogenetic study focuses only on intraspecific (spatial, phenetic) variation of *S. poinsettii*. The author, at the risk of being scorned and scoffed as an old-fashioned fuddy-duddy, admits to the general acceptance of subspecies and the need to at least expose and describe the discrete kinds of geographic variation of the wide-ranging *S. poinsettii* (see discussion in Smith et al., 1997). Of course, there are different kinds of subspecies (degrees of distinctness) with recognition dependent on the whims of the investigator. The two most distinctive populations, *S. p. macrolepis* and *S. p. polylepis* (not mere "pattern classes"), would seem to reflect corresponding genetic differences (perhaps two species) if not for the interposed continuum of morphological variants. The five subspecies of *S. poinsettii* (two described herein as new) are peripherally oriented with each having geographical integrity and exhibiting intergradation in mutual contact zones (Fig. 11).

Methods

Data recorded for each specimen included sex, snout-vent length (SVL), and numbers of dorsal scales, scales around midbody, femoral pores, scales between pore series, canthals, loreals, preoculars, and frontoparietals. Other features included notation of the anterior part of the frontal (entire or longitudinally divided), the arrangement of scales (symmetrical or irregular) in the posterior part of the frontal-frontoparietal area, the frequency of contact of the two prefrontals and of the anteriormost sublabial (outer row) and mental, and aspects of dorsal head and body pattern. The approximate color pattern in life of several individuals has been preserved for reference on 2 x 2 color slides. Lee (1990) heralded the potential error fraught with meristic counts. Counts of dorsal scales have been repeated more than once for some specimens and performed only by the author; although the numbers of dorsal scales are employed in making taxonomic decisions, the possible error of one or two scales is negligible when considering the overall disparate ranges of variation in conjunction with other taxonomic features.

A description of the species that encompasses range-wide variation is followed by the accounts of subspecies, a discussion of intergradation, and a final comparison of taxonomic characters (with key). Photographs of dorsal head and body patterns accompany the descriptive comments of each subspecies. The original spelling of *poinsettii* is retained (rather than the incorrect subsequent spelling, *poinsetti*, ICZN, 1999, Art. 33.4). Locality data for specimens examined are listed, and many reference citations (Literature

Cited) that document examined specimens appear only, in the Appendix. Eponyms used there and elsewhere in the text denote specimens in the following institutions: **AMNH**, American Museum of Natural History, New York, New York; **ASNHC**, Angelo State Natural History Collection, San Angelo, Texas; **ASU**, Arizona State University, Tempe, Arizona; **BYU**, Monte L. Bean Museum, Brigham Young University, Provo, Utah; **CAS**, California Academy of Sciences, San Francisco, California; **CM**, Carnegie Museum, Pittsburgh, Pennsylvania; **EAL**, Ernest A. Liner, private collection (now AMNH); **FMNH**, Field Museum of Natural History, Chicago, Illinois; **GNHC** (formerly WNMU), Gila Natural History Collection, Western New Mexico University, Silver City, New Mexico; **KU**, Museum of Natural History, University of Kansas, Lawrence, Kansas; **LACM**, Los Angeles County Museum of Natural History, Los Angeles, California; **MCZ**, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; **MSB**, Museum of Southwestern Biology, University of New Mexico, Albuquerque, New Mexico; **MSUM**, The Museum, Michigan State University, East Lansing, Michigan; **MVZ**, Museum of Vertebrate Zoology, University of California, Berkeley, California; **NMSU**, New Mexico State University, Las Cruces, New Mexico; **RWA**, Ralph W. Axtell, private collection (number of uncataloged specimens in brackets); **SDSNH**, San Diego Society of Natural History, Balboa Park, San Diego, California; **SMBU**, Strecker Museum, Baylor University, Waco, Texas; **TCWC**, Texas Cooperative Wildlife Collection, Texas A&M University, College Station, Texas; **TNHC**, Texas Natural History Collections, Texas Memorial Museum, University of Texas, Austin, Texas; **UAZ**, University of Arizona, Tucson, Arizona; **UBIPRO**, Laboratorio de Herpetología, Unidad de Biotechnología y Prototipos, Escuela Nacional de Estudios Profesionales Iztacala, UNAM, Los Reyes Iztacala, Tlalnepantla, Edo. de Mexico, México (cited numbers same as "JLE" [J. Lemos-Espinal] field numbers indicated in publications; some specimens may be at UCM); **UCM**, University of Colorado Museum, Boulder, Colorado; **UIMNH**, University of Illinois Museum of Natural History, Urbana, Illinois; **UMMZ**, University of Michigan, Museum of Zoology, Ann Arbor, Michigan; **USNM**, National Museum of Natural History, Washington, D.C.; **UTA**, University of Texas at Arlington, Arlington, Texas; **UTEP**, University of Texas at El Paso, El Paso, Texas.

Species Description

Sceloporus poinsettii Baird and Girard

Crevice Spiny Lizard

Etymology. The species name honors Joel R. Poinsett, first Minister of the United States to Mexico (appointed 1825), Secretary of War (1837-1841), and influential in targeting the Smithson endowment for the establishment of the ultimate National Museum of Natural History (USNM).

Types. The original type-material consisted of five specimens from two different localities. Webb (1988) described the five syntypes, restricted the two localities, and designated the two specimens of USNM 2952 (both since recataloged as USNM 292580) from Grant County, New Mexico, as lectotype (adult male) and paralectotype (adult fe-

male). The other three Texas syntypes (= paralectotypes) from the Río San Pedro represent a different subspecies. Smith and Taylor (1950a:125, 1950b:363) had previously restricted the type locality to the Río San Pedro (= Devils River, Val Verde County), Texas, without comment (see Bell et al., 2003:149).

Description

Color and Pattern. The top of the head may be mostly patternless pale brown or black, or have a contrasting white-speckled pattern. The rear of the head may be blackish with postocular white bars and a few scattered white spots or the pattern consists of narrow, postocular dark stripes (below) and enlarged pale postocular blotches (above) that indent the sides of a dark, medial, cruciform (X-shaped) blotch. A pale band across the rear of the head between the ear openings (hereafter as the intertympanic band) is usually either complete across the neck, narrowly interrupted medially, or broken into a series of closely aligned pale spots, but may be almost absent. A dark transversely oriented nape blotch separates the pale intertympanic band and pale anterior border of the black collar. Pale longitudinal segments may flank the dark nape blotch interconnecting the pale intertympanic band and the anterior border of the black collar. A pale supralabial stripe, extending posteriorly through the ear opening, may be confluent with the lateralmost parts of the pale anterior border of the black collar. The uninterrupted, black, white-bordered collar is of varying width (two to six scales middorsally) with the widest collars having the posterior margin curved or gently angled. A small pale (blue in life) scale (or scales, spot) usually occurs just above the shoulder on the side of the neck within the black collar. White markings occasionally occur within the black collar. The whitish borders (both usually about two scales wide) of the black collar may be narrowly interrupted medially (often by short black streaks, see Fig. 2 in Webb, 1988); the anterior border may be disrupted into a series of spots.

Dark crossbands on the back (two to five, usually three or four, excluding sacral band) are of varying width and may be either complete across the back, bifurcated laterally to varying degrees, confined to vertebral blotches, disrupted into a non-banded, irregular pattern of small dark marks, or dorsal surfaces are mostly patternless. Sides of the body (in life) may be yellow, pale orange, or reddish; some body scales otherwise may be reddish, or pale orange, or blue-green. Dorsal body scales may have black edges aligned to form narrow longitudinal lines. Tails are usually marked with contrasting black (widest) and white alternating bands with black bands forming rings (less distinct ventrally) toward the tip of the tail.

The underside of the head (throat pattern) in young and subadults of both sexes has a dark blue irregular barred/spotted, or mottled pattern of varying distinctness, often with a pale longitudinal medial streak; this juvenile pattern may persist in both sexes exceeding 100 mm SVL, but may be mostly absent in some juveniles depending on geographic occurrence. Usually belly patches in females are indicated by either a pale blue wash or are relatively distinct with dark medial borders and with some dark pigment across the throat, on the chest, midventrally, and in the groin; these color patterns are

brightest and most extensive in the largest males. The blue-black belly patches may be confluent midventrally in places. The distinctness of blue belly patches is variable in some Chihuahuan females; patches may be almost absent (UBIPRO 4024, SVL 92 mm; UBIPRO 4306, SVL 100 mm SVL), restricted posteriorly (UBIPRO 4303, SVL 99 mm), but may be well-developed (UBIPRO 4310, SVL 105 mm). A male (UBIPRO 3707, SVL 84 mm, Chihuahua, enlarged postanal scales) lacks blue belly patches. Lemos-Espinal et al. (2001) also commented on ventral blue coloration in some other Chihuahuan females (absent to strong), and a male (111 mm SVL) having the entire median area black. Adults of both sexes often have (in life) a pale orangish wash concentrated in the preanal-base of tail area (extending onto femora). The peritoneum is black.

Scutellation. The supraocular scales are divided, but the size of the scales of the medial row is variable. The scales of the lateral and medial rows are either subequal in size (Fig. 1A) or those of the medial row are often noticeably larger than those of the lateral row tending toward undivided supraoculars (Fig. 1B, C; also in Smith, "1936"[1938]:608, Fig. 15, same in Smith, 1939:223, Fig. 30); one specimen at least (UTEP 14630, east Escalón, Chihuahua) does have undivided supraoculars (Fig. 1D). Adjacent scales of the two rows may be fused forming one undivided supraocular. Two adjacent scales of the enlarged medial row of supraoculars may be fused (UTEP 14657). Occasionally a gap in the row of circumorbitals permits contact of a supraocular and a medial head scale. Dorsal snout scales consist of usually four postrostrals, followed by irregular arrangement of supranasals and internasals (usually four scales between nasals), three frontonasals, and two prefrontals (separated, often by azygous scale, or in medial contact). The frontal is usually transversely divided (entire in UBIPRO 1924, 1933, 1944, 1954). The anterior frontal is either entire or longitudinally divided. The posterior frontal is either entire, divided (longitudinally or transversely), or scutellation is irregular (often subdivided into three scales). Frontoparietals usually number one (or two) and may touch medially (often separated by azygous scale). The posterior dorsal head scales (posterior frontal-frontoparietal area) are frequently and variably irregularly fragmented (Fig. 1B, D); some medial head scales may be irregularly fused (Fig. 1C). The maximal extent of head-scale irregularity noted for the species occurs in a male (UTEP 14655, SVL 115 mm, Sierra Jardin, Coahuila) in which many named scales (canthal-loreal region, frontonasals, prefrontals, anterior half of frontal, parietals) are unrecognizable and fragmented into small irregularly arranged scales.

Lateral head scales consist of a subnasal, one or two canthals (counted as two if both touch loreal), one (usually) or two loreals, one or two (rarely fragmented into three) preoculars, and usually two rows of lorilabial scales. Occasional fusion of lateral head scales may involve the anterior canthal and subnasal (MSB 6327, 20504, 20510), the posterior canthal and loreal (RWA 5223), one canthal and loreal (NMSU 6301-02), the lower preocular and loreal (UTEP 8878, 9461), and the lower preocular and subocular (ASNHC 3818, 3823, 3825); the anterior canthal may contact a supralabial thus separating the subnasal and loreal scales (UTEP 13693). The anteriormost sublabial (outer row) infrequently contacts the mental (postmental usually touches first infralabial). Snout scales are usually pitted (variable in extent), except in young.

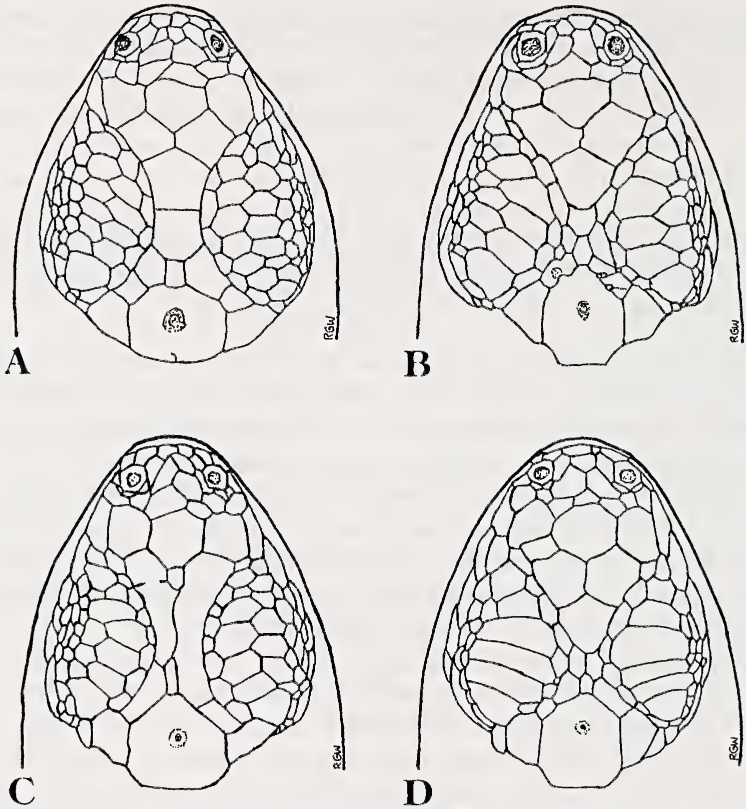

Fig. 1. Dorsal head scutellation of *Sceloporus poinsettii* showing variation in size of divided supraoculars and configuration of scales in posterior frontal-frontoparietal region. Divided supraoculars either usually equal-sized (A) or medial row enlarged (B, C), and posterior medial head scales either symmetrical (A) or usually subdivided and irregularly arranged (B, D); extensive fusion of medial head scales (C) and undivided supraoculars (D) are rare variants. A, UTEP 4831, *S. p. macrolepis*; B, UTEP 13735, *S. p. axtelli*; C, UTEP 9230 and D, UTEP 14630, intergrades.

Dorsal body scales along the middle of the back (about 6-7 longitudinal rows) in large adults (exceeding about 110 mm SVL, but occurring at smaller sizes) are mostly smooth (keeled in smaller individuals); Baird and Girard (1852) noted smooth scales in the original description of *S. poinsettii*. Dorsal scales range from 25 to 43, scales around midbody 31 to 47, femoral pores 7 to 16 (one leg) with extremes of 7-7 and 14-16, and fewest number of scales between pore series 6 to 17. Males (with pair of enlarged postanal scales, and larger femoral pores in adults than in adult females) attain a larger size than females (Fitch, 1978, 1981). The largest male examined is 133 mm SVL (UTEP 4457), female 123 mm SVL (UTEP 14599); Ballinger (1973:273) recorded 128 mm for a Texas female. The maximal size of adults of *S. poinsettii polylepis* is not known to exceed 100 mm SVL.

Distribution. *Sceloporus poinsettii* is widespread in suitable rocky habitat from southern New Mexico and central and western Texas south into northern México through Chihuahua and Durango (and the eastern highland parts of Sonora and Sinaloa) and Coahuila into northern Zacatecas and San Luis Potosí, and eastern Nuevo León. The species may occur farther south in Jalisco (see Distribution, *S. poinsettii macrolepis*). A distribution map (Fig. 11) accompanies the list of localities in the Appendix.

Preferred habitat is rock outcrops or large boulders (igneous or sedimentary) with suitable cracks and crevices of either low, dry, isolated, desert hills or more mesic, pine-oak forested, mountainous terrain. On occasion individuals may climb trees. Known elevations range from 231 m or 700 ft (Comal County, Texas, Axtell, 1987) to near 2743 m or 9200 ft (near Las Adjuntas, Durango).

Accounts of Subspecies

The following accounts of the five subspecies of *Sceloporus poinsettii* provide proposed common names (two for Mexican taxa follow Liner, 1994), recognition features (those in combination most diagnostic), descriptions (color and pattern, and scutellation), and a statement of distribution. Taxonomic characters and recognition features that differentiate subspecies (with key) are discussed beyond in the section Comparisons.

Sceloporus poinsettii poinsettii Baird and Girard

New Mexico Crevice Spiny Lizard

Sceloporus poinsettii Baird and Girard, 1852:126. Lectotype, USNM 292580, adult male in fluid, from either the southern part of the Big Burro Mountains or the vicinity of Santa Rita, Grant County, New Mexico; obtained in late August 1851 by John H. Clark in company with James D. Graham during tenure with the U.S.- Mexican Boundary Commission. The lectotype, a male of about 115 mm SVL, was redescribed by Webb (1988), and dorsal pattern features were illustrated by Baird (1859) and Webb (1988). The lectotype and female paralectotype, originally USNM 2952 (n = 2), were both recatalogued as USNM 292580 on 13 December 1989.

S[*celoporus*]. *p*[*oinsetti*]. *poinsetti*, Smith and Chrapliwy, 1958:268.

Recognition. A subspecies of *Sceloporus poinsettii* recognized by combination of: (1) distinct crossbands on body (usually four), but most scales pale and dark-edged, (2) dark top of head with distinct, small white spots and markings, (3) dorsal body scales not less than 29 or more than 35, and (4) anterior frontal longitudinally divided (98%).

Description. Color and pattern. *Sceloporus p. poinsettii* is most readily identified by the distinct, pale-speckled, dark (may be near black) top of the head and pale-streaked dark crossbands on the body. Indication of a black cruciform blotch may occur on the rear of the head (Fig. 2, see Comparisons). The pale intertympanic band (one or two scales wide) is complete or interrupted (at least medially) and may be faded or dis-

tinct. The anterior and posterior white borders (usually two scales wide) of the black collar may be entire, but both are often narrowly interrupted, at least medially. The posterior margin of the collar is either mostly straight (collar relatively narrow) or curved (collar slightly widened vertebrally); the width of the collar generally encompasses three or four (rarely five) black scales. The black collar may enclose whitish marks (UTEP 9602, Fig. 2). Distinct, dark (usually black) crossbands on the body (usually four, or three) are relatively straight (or slightly undulating), and may be interconnected with narrow dark (near vertebral) segments (Fig. 2). These body crossbands are usually pale-streaked (pale scales with black edges or encircled by black). Pale interspaces between crossbands usually lack dark-edged scales, but such scales may be aligned with those of the crossbands to form continuous longitudinal black lines (AMNH 109129, Fig. 2). Large males have the medial black borders of the blue ventrolateral belly patches attenuated anteriorly from large black groin patches; dusky to blackish pigment may be extensive across the chest and confluent midventrally in places. Adults of both sexes may have the sides of the body washed with pale orange or yellow-orange. New-born young (31-33 mm SVL, UTEP 9605, n = 8, young born to UTEP 9603, both in Fig. 2) have dark dots in the posterior parts of the pale brown crossbands and an indistinct dark-streaked pattern; the juvenile streaked and marbled pattern on the throat is mostly faded and diffuse, but with a few distinct bars. Illustrations of dorsal patterns are in Smith ("1936"[1938]:685, Pl. 51, Fig. 1), Behler and King (1979:Pl. 354, color), Stebbins (1954:237, Pl. 358; 1966:Pl. 23, color [same 1985:Pl. 27, and 2003:Pl. 31, both color] based on specimen from northwest Antelope Wells fide Philip A. Medica, see Appendix, Additional records), Williamson et al. (1994:91, color), and Degenhardt et al. (1996:Pl. 51, color).

Scutellation. The scales of the medial and lateral rows of the divided supraoculars generally are subequal in size; occasionally the scales of the inner (medial) row are somewhat larger than the scales of the outer (lateral) row (e.g., UTEP 10048, 11155, 12429), especially so in UTEP 12418 suggesting undivided supraoculars. The posterior dorsal head scales (posterior frontal-frontoparietal area) are usually irregular in varying degrees; this kind of variation is highlighted by UTEP 12428 in which the two parietal scales are subdivided and UTEP 12429 having the frontoparietals longitudinally divided.

The mean number of dorsal scales is 31.9 (29-35, 98% 34 or less, n = 202), midbody scales 37.3 (34-42, n = 172), femoral pores 22.0 (18-26, n = 187, both legs) or 11.0 (8-13, n = 382, one leg), and scales between femoral pore series 9.6 (7-12, n = 194). Canthal scales (each side of head, n = 405) are more frequently two (61%) than one (39%), occurring in combinations (both sides of head, n = 202) of 1-1 (28%), 1-2 (23%), and 2-2 (49%). Preocular scales (each side of head, n = 408) most often number one (95%), with combinations (both sides of head, n = 204) of 1-1 (92%), 1-2 (5%), and 2-2 (3%). The anterior frontal is longitudinally divided (98%, n = 205). The prefrontals (n = 195) are either separated (53%, most often by an azygous scale) or are in broad medial contact (47%, rarely partly separated by a small azygous scale). The separation of the anteriormost sublabial scale (outer row) and the mental (each side of head, n = 200) is slightly more frequent (56.5%) than contact of those two scales (43.5%). The largest male is 128 mm SVL (MSB 4212) and female 115 mm SVL (ASNHC 10643).

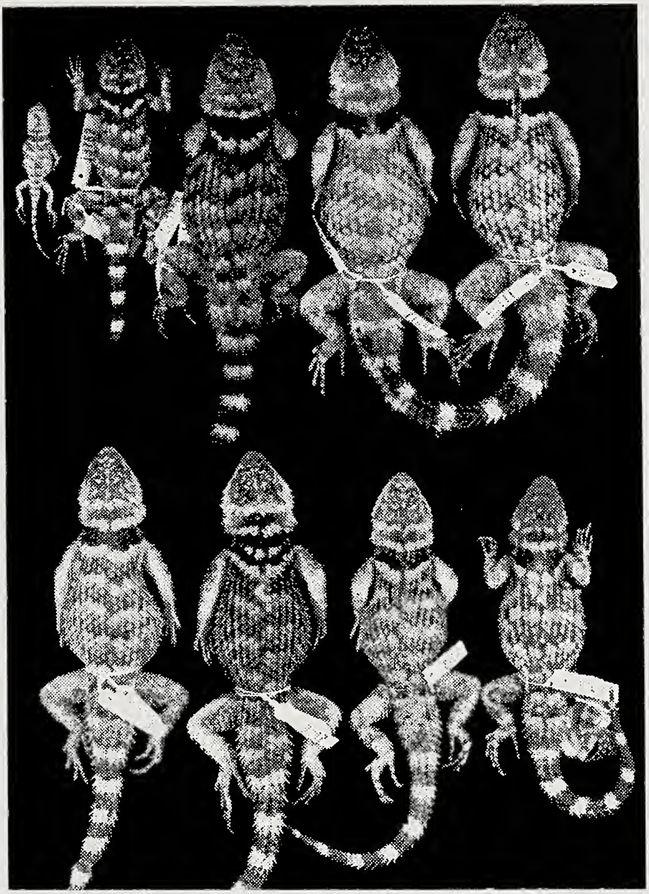

Fig. 2. Dorsal patterns of *Sceloporus p. poinsettii* (southwestern New Mexico, all Hidalgo County except as indicated). **Upper**, left to right (all females): UTEP 9605 (n = 8), hatchling, 32 mm SVL; UTEP 13752, 69 mm SVL; AMNH 109129, 94 mm SVL; UTEP 11507, 104 mm SVL (Grant Co.); UTEP 11155, 102 mm SVL. **Lower**, left to right: UTEP 9603, female, 97 mm SVL; UTEP 9602, male, 104 mm SVL; UTEP 8714, male 88 mm SVL (Socorro Co.); UTEP 495, female, 82 mm SVL (Grant Co.)

Some minor differences in scutellation occur when the geographic isolate in Hidalgo County (see Distribution) is compared with the large segment of *S. p. poinsettii* to the north. This Hidalgo sample is centered in the southern Animas Mountains area (includes all specimens from Hidalgo County except those from just west of Animas and Cotton City). The size of the dorsal scales is about the same in the Hidalgo sample (averaging 31.7, 29-34, n = 51) and in the more northern population (32.1, 29-35, n = 145). In the Hidalgo sample the anteriormost sublabial is separated from the mental (each side of head, n = 54) more frequently (72%) than the two scales are in contact (28%), whereas the respective values, reversed for the northern sample of *S. p. poinsettii* (n = 134), are

47% and 53%. The frequency of one or two preoculars (usually one), increases slightly between the Hidalgo sample (each side of head, n = 102) and the northern sample (n = 294) with respective values of one preocular 82% and 99%. The prefrontals in the Hidalgo sample (n = 43) are in medial contact (58%) or separated, usually by an azygous scale (42%), but in the northern population (n = 146) the respective values are 44% and 56%. These respective values for the two New Mexico samples (except prefrontals) fit into an overall pattern of north-south geographic variation in the Sierra Madre Occidental (see discussion of Morphological Intermediate Variants).

Cole et al. (1967) cited UAZ specimen numbers 15972 (male) and 15976 (female) as vouchers for illustrations of karyotypes; these specimens represent *S. p. poinsettii* and are from near Pinos Altos, Grant County, New Mexico (see Appendix).

Distribution. *Sceloporus p. poinsettii* occurs west of the Río Grande in southwestern New Mexico. Individuals occur in hilly landscapes with scattered juniper or pinyon pine and juniper, and in pine-oak forests in the Black Range, Mimbres, San Mateo, Magdalena, and to the west, the Burro, Mogollon, and Tularosa mountains. They seem to be absent north of the San Augustine Plains (Datil-Gallinas mountains) and to the west in the San Francisco and Gallo mountains. One of the easternmost specimens from Socorro County (SW Socorro, MSB 4220) is recorded from a habitat of creosote, mesquite and grass. In some areas *S. p. poinsettii* seems to be replaced at lower elevations by *Sceloporus clarkii* (on rock outcrops, trees). *Sceloporus poinsettii* (UTEP 16078, on rock outcrops) and *S. clarkii* (UTEP 16080-81, on trees) occur together at least in Sierra County, New Mexico (Mimbres Mts, Pierce Canyon, ca. 13 air km NW Lake Valley).

Two populations to the south in Hidalgo County may be isolated from those to the north and from each other. These isolates are from low, foothill areas of the southern Animas Mountains, and the black-bouldered lava fields (malpais) that cover flatlands in the north-south trending Animas Valley between the Animas and Peloncillo mountains (west of Animas and Cotton City, ca. 1304 m or 4280 ft). The species is not known from the northern drier part of the Animas Mountains (*S. clarkii*, UTEP 11264, occurs here on rock outcrops) or in the Pyramid Mountains immediately adjacent to the north.

The entire range of *S. p. poinsettii* seems to be largely disjunct; this isolation was alluded to by Lowe (1955) and indicated on an inset map in Axtell (1987). The species is not known to occur in the Peloncillo Mountains immediately adjacent to the west of the Animas Mountains (*S. clarkii* here on rock outcrops, low elevations) or in Arizona (but see Additional records in Appendix). To the south *S. poinsettii* seems to be absent in the east-west trending Sierra de San Luís in México that straddles the Sonora-Chihuahua border just south of the Animas Mountains (David Barker and Charles Painter, pers. convers.; none observed by author at two different sites in summer of 1983); the occurrence of *Sceloporus grammicus* in the Sierra de San Luís (Degenhardt et al., 1996:360) and absence in the Animas Mountains further highlights this geographic break. Also *S. poinsettii* does not seem to occur in the sizeable, mountainous uplift of suitable rocky habitat (Sierra del Fresnal) about 24 road miles northeast of Ascención, Chihuahua (site

east microondas entrance, Hwy 2; several visits by author and Ralph W. Axtell). The record of occurrence nearest to those of *S. poinsettii* in Hidalgo County, New Mexico is west of Janos, Chihuahua (Tanner, 1987).

Eastward *S. p. poinsettii* is limited by the Río Grande drainage, and is seemingly absent in suitable habitat of isolated, dry mountainous uplifts across southwestern New Mexico (see Appendix, Additional records). The species is not known to occur in the north-south trending Big and Little Hatchet and Alamo Hueco mountains, but individuals are abundant in the Cedar Mountains adjacent eastward. The species is absent farther east in the Tres Hermanas, Florida, West and East Potrillo mountains, and (east of Río Grande) the San Andres-Organ-Franklin mountain chain. Thus, in New Mexico, *S. p. poinsettii* is rather widely separated from the different subspecies to the east in the Sacramento Mountains (eastern New Mexico) and the Hueco Mountains (El Paso and Hudspeth counties, Texas) and eastward (Fig. 11). This east-west hiatus in range of *S. poinsettii* probably relates to the history of the ancestral Río Grande and extensive interposed early Pleistocene Lake Cabeza de Vaca (see Axtell, 1977). Of corroborative interest are the different helminth species noted for Texas and western New Mexico populations of *S. poinsettii* (Goldberg et al., 1993).

Sceloporus poinsettii macrolepis Smith and Chrapliwy

Largescale Crevice Spiny Lizard

Sceloporus poinsetti macrolepis Smith and Chrapliwy, 1958:268. Holotype, UIMNH 35455, adult male in fluid, from El Salto, Durango, ca. 2469 m (8100 ft), obtained 1952-1953, by [given names unknown] Barden and I. Lester Firschein. Three paratypes (UIMNH 35453-54, 35456) are listed as topotypes. The holotype (examined by author) is a male of about 98-100 mm SVL, having large (26-27) dorsal scales, an entire anterior frontal, and characteristic dorsal patterns.

Sceloporus p[oinsettii]. robisoni Tanner, 1987:398. Holotype, BYU 14287, adult male in fluid, from Cuiteco, Chihuahua; obtained 19 July 1958 by Wilmer W. Tanner and W. Gerald Robison, Jr.

Recognition. A subspecies of *Sceloporus poinsettii* identified by combination of: (1) broad dark (mostly solid color) crossbands (usually two or three) on body, (2) top of head mostly patternless, uniformly dark, often black, (3) black collar often enlarged and curved posteriorly, (4) large dorsal body scales not more than 31, and (5) anterior frontal entire (93%), not longitudinally divided.

Description. Color and pattern. *Sceloporus p. macrolepis* has a mostly patternless top of the head, often wide black collar, and broad, unicolor, dark crossbands on the body. The top of the head is pale to dark brown, often black; some scales may have indistinct pale flecks. Pale postocular blotches are rather indistinct in young, and absent or nearly so in large adults. Pale intertympanic bands are usually interrupted into white spots, but may be faded and indistinct (or almost absent). Anterior and posterior white borders of the black collar (both about two scales wide) are usually entire, not interrupted

medially. The black collar is usually lengthened vertebrally (five to six black scales), the posterior border gently curved to somewhat angular. Dark crossbands on the body, usually two or three, are broad and distinct and of solid color, and separated by narrow pale interspaces (one or two scales wide). Rarely crossbands are narrower and four in number, or some adjacent crossbands are interconnected (MSUM 9334). The posteriormost crossband may be partly fused with the sacral blotch. Pale body scales of interspaces may have dark edges that align with those of crossbands to form longitudinal dark lines. In life the eye is rimmed in pale red and body scales may have a pale orange tinge. Young have a bold, dark blue marbled pattern (mostly irregular barring) on the underside of the head. Variation in dorsal patterns is shown in Fig. 3.

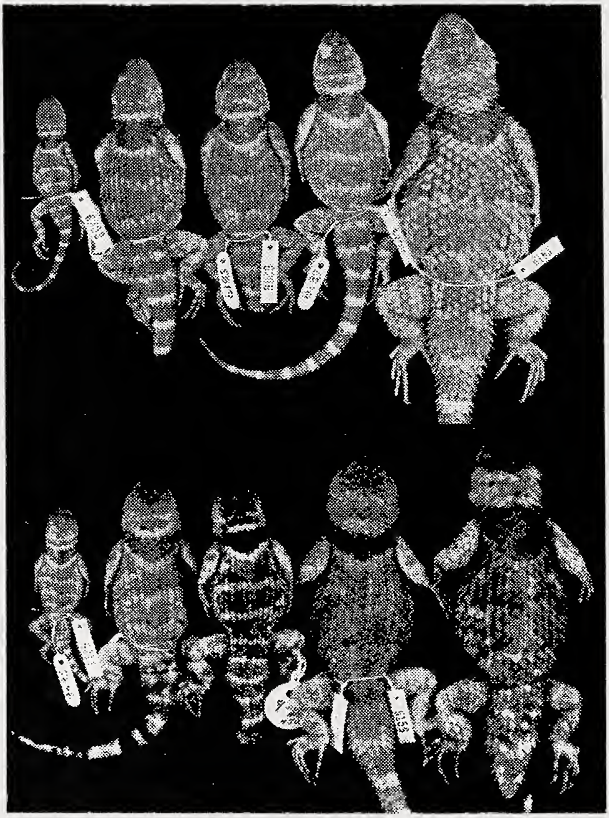

Fig. 3. Dorsal patterns of *Sceloporus p. macrolepis* (all Durango, Mexico). **Upper**, left to right: UTEP 6203, male, 43 mm SVL (SE Llano Grande); UTEP 1317, female, 72 mm SVL (SW El Salto); UTEP 6206, female, 75 mm SVL (SE Llano Grande); UTEP 6205, female, 75 mm SVL (SE Llano Grande); UTEP 6165, female, 117 mm SVL (Rio Chico). **Lower**, left to right: UTEP 6211, male, 48 mm SVL (E Llano Grande); UTEP 6175, female, 75 mm SVL (E Las Adjuntas); MSUM 9340, female, 75 mm SVL (S Tepehuanes); UTEP 6159, male, 104 mm SVL (W Metates); MSUM 3140, female, 112 mm SVL (ESE Cajones). See Morphological Intermediate Variants regarding UTEP 6159 and 6165.

Scutellation. Scales of the divided supraoculars are generally subequal in size, and the posterior frontal and frontoparietals often are not irregularly subdivided (Fig. 1A).The mean number of dorsal scales is 28.6 (25-31, n = 97), midbody scales 35.4 (31-38, n = 87), femoral pores 21.3 (14-27, n = 76, both legs) or 10.6 (7-14, n = 152, one leg), and scales between femoral pore series 9.4 (7-12, n = 66). Canthals (each side of head, n = 148) are usually two (91%), occurring in combinations (both sides of head, n = 74) of 1-1 (8%), 1-2 (1%), and 2-2 (91%). Preocular scales (each side of head, n = 148) are most often one (70%) rather than two (30%), with combinations (both sides of head, n = 74) of 1-1 (65%), 1-2 (11%), and 2-2 (24%); in three counts of two preoculars, the area is divided into three scales. The anterior frontal is entire, not divided longitudinally (93%, n = 98). The prefrontals (n = 74) are usually in broad contact medially (89%) or are separated (11%, by an azygous scale only in two). The anteriormost sublabial scale (outer row) and the mental are separated (each side of head, 94%, n = 112). Boulenger (1897:480) reported 11-12, 11-12, and 12-12 femoral pores, 29, 27, and 27 dorsal scales, and 36, 37, and 34 midbody scales for three specimens from La Ciudad, Durango. The largest male is 110 mm (UCM 20947, maximal size doubtless much larger) and female 120 mm SVL (RWA 5232); McDiarmid et al. (1976:9) recorded 125 mm SVL (in error) for JFC 69-135 (= CAS 155909), a male of about 100-103 mm SVL (verified by Jens Vindum, pers. comm.).

Distribution. *Sceloporus p. macrolepis* is confined to the pine-oak forested highlands and the higher eastern slopes of the Sierra Madre Occidental. Records of occurrence in Durango and southern Chihuahua are at approximate elevations between 1981 m (6500 ft) and 2804 m (9200 ft); the lowest elevation recorded is 1800 m (5904 ft) in Sinaloa (see below). The northernmost limits seem to be just north of the Barranca del Cobre in the vicinity of Mojárachic and Maguarichic; farther north with gradual decrease in elevation the change in the suite of recognition characters of *S. p. macrolepis* suggests intergradation in northern Chihuahua and adjacent Sonora with *S. p. poinsettii* (see discussion of Morphological Intermediate Variants). The species is limited to the west by tropical landscapes (Mixed Boreal-Tropical habitat in Durango; here replaced by *S. bulleri*, Webb, 1984). However, *S. p. macrolepis* occurs near 1800 m in an isolated forested outlier, the Sierra Surutato in northern Sinaloa (McDiarmid et al., 1976), and is to be expected elsewhere in the easternmost, non-tropical, highland parts of the Sierra Madre in Sinaloa. *Sceloporus poinsettii* is presumably absent in suitable pine-oak woodland of some outlier ranges to the east of the southern part of the Sierra Madre Occidental, at least the Sierra de Valparaiso, Zacatecas (visited by author), and the Sierra Fria, Aguascalientes and the Sierra Morones, Zacatecas (Wilson and McCranie, 1979); *S. poinsettii* is not mentioned in the herpetofaunal account of Aguascalientes by McCranie and Wilson (2001).

However, one specimen of *S. poinsettii* (CAS 169632) is currently geographically isolated in southern Jalisco in the Sierra de Manantlán, 2.9 mi S Asseradero Manantlán [= Rincon de Manantlán, ca. 19°36'N, 104°12'30"W] or 14.2 [road] mi S El Chante on road from El Chante [19°43'N, 104°12'W] to El Guisar [not located], 17 August 1980, J.F. Copp, D.E. Breedlove, and F. Ameda. The collection site is some 395 air km (245 mi)

south of the nearest locality to the north in the Sierra Madre Occidental (Rancho Las Margaritas, Durango, 23°18'N, 104°17'W, south of the Río Mezquital near the Zacatecas border). The composite descriptive aspects of the one male (enlarged pair of postanal scales, 89 mm SVL, Fig. 4) with large dorsal scales (ca. 30-31), 38 around midbody, 12-13 femoral pores (series separated by 8 scales) are encompassed by the range of variation of *S. p. macrolepis*. Unusual is the divided anterior frontal (usually entire in *S. p. macrolepis*, 93%, n = 98), the 1-1 canthals (usually two in *S. p. macrolepis*, 91%, n = 148), and the near loss of blue-black ventral pigmentation (only indistinct dark throat markings and slightly darkened sides and midventral area of the belly). This Jalisco specimen is not further discussed or plotted on the distribution map (Fig. 11).

Remarks. Tanner (1987) described *Sceloporus poinsettii robisoni* based on 14 specimens from three localities (Cuiteco, Cerocahui, and near Maguarachic), which generally are in pine-oak forested highlands of the Sierra Madre Occidental in southwestern Chihuahua. I examined these specimens prior to Tanner's description of *robisoni* at which time I identified them as *S. p. macrolepis* based on the characteristic dorsal patterns and especially all specimens having an entire (not longitudinally divided) anterior frontal (but divided northward). Tanner mentioned four traits in his diagnosis: (1) adults large, 110-115 mm SVL. The maximal size of all populations of *S. poinsettii* is large, except for the distantly removed *S. p. polylepis* (southeasternmost subspecies, Fig. 11) with maximal sizes less than 100 mm SVL. (2) dorsal scales, 29-32. In my examination of these specimens the highest count was 31. Tanner's data (30.4, 29-32) are encompassed by, but at the upper limits of, the range of variation of *S. p. macrolepis* as here defined (28.6, 25-31, n = 97); however the mean number of dorsal scales increases northward in the Sierra Madre Occidental to 31.7 and 32.1 in the two New Mexico populations of *S. p. poinsettii* (see descriptive account of *S. p. poinsettii* and discussion of Morphological Intermediate Variants). (3) postmentals not in contact with infralabials. This character is expressed here relative to the contact or separation of the anteriormost sublabial and mental; contact of these two scales is equivalent to separation (prevents contact) of the postmental and first infralabial (on either side). This feature of scutellation was not recorded by me for the 14 specimens of *robisoni*; however, Tanner recorded labiomental [= sublabial]-mental contact in 50% of the 14 specimens of *robisoni* (including the holotype). My data for *S. p. macrolepis* indicate these scales in contact in only 6% (n = 112); however this value increases northward and is maximized in the two New Mexico *S. p. poinsettii* populations (28% and 53%, see discussion of Morphological Intermediate Variants). (4) fewer femoral pores, 85% with 20 or less. Tanner recorded a femoral pore count (both legs) of 14 (7-7) in the holotype with a mean of 18.6 (14-21) for the 14 specimens of *robisoni*. Seven is the lowest number of femoral pores (one leg) recorded for *S. poinsettii* and is of rare occurrence; in my data that number is recorded elsewhere for only four specimens (7-7, UAZ 39421, [NW] Yécora, Sonora; 7-8, UAZ 35182, La Mesa Tres Rios, Sonora; 7-9, UTEP 1837, Hueco Mts, El Paso County, Texas; and 7-9, UBIPRO 2331, Rancho El Setenta, NE Chihuahua). My data for femoral pores of *S. p. macrolepis* are means of 21.3, both legs (16-27, n = 76) and 10.6, one leg (8-14, n = 152) with 25 of 76 (33%) having 20 femoral pores or less, and are about the same in *S. p. poinsettii*, respectively, 22.0 (18-26,

n =187) and 11.0 (8-13, n = 382).

Tanner's sample of 14 specimens was fortuitous in having a combination of a somewhat high frequency of low femoral pore counts and contact of labiomental (= sublabial) and mental. Based on overall trends of geographic variation of *S. poinsettii* range-wide, I choose not to recognize *S. p. robisoni*, and regard *robisoni* as a synonym of *macrolepis*. Lemos-Espinal et al. (2001:206) and Bell et al. (2003:111) also regarded *S. p. robisoni* as invalid.

Sceloporus poinsettii amydrus **subsp. nov.**

Clouded Crevice Spiny Lizard

Sceloporus poinsettii amydrus. Holotype, UTEP 6190, female in fluid, 3.7 road miles (unpaved) south of González Ortega [site is ca. 23°54'30"N, 103°27'25"W], Zacatecas, ca. 2210 m (7249 ft); obtained 15 July 1977 by Robert G. Webb (original field number 6522) in company with Rollin H. Baker and Mary W. Baker. One other topotype (UTEP 6189, male, 40 mm SVL) has same collection data as the holotype.

Description of holotype. Female, 86 mm SVL; dorsal body scales 28 and scales around midbody 36; both anterior and posterior frontal entire; frontoparietals 2-2 and in medial contact; prefrontals in medial contact; canthals 2-2, loreals 1-1, preoculars 1-2, and anteriormost sublabial not touching mental; femoral pores 14-14 with eight scales

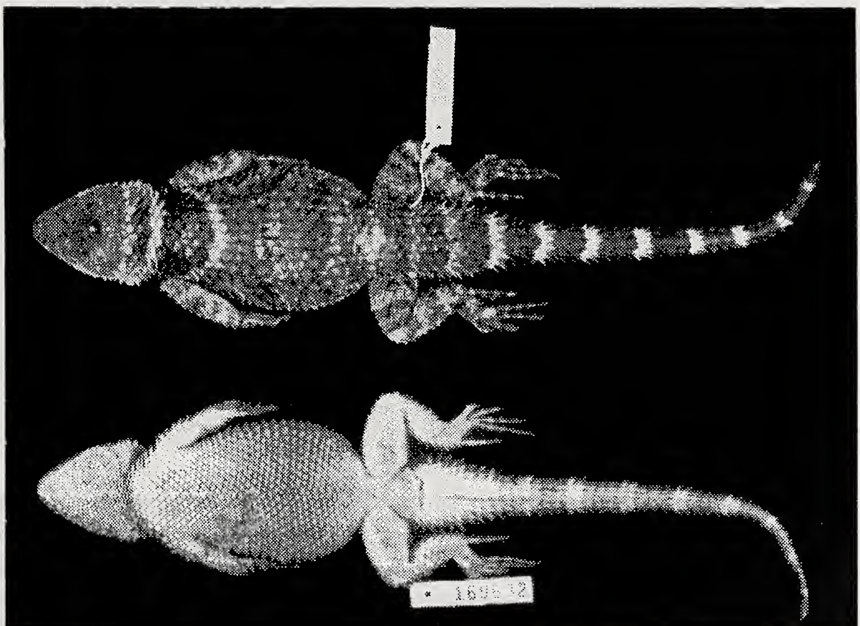

Fig. 4. Dorsal and ventral views of *Sceloporus poinsettii* (CAS 169632, male, ca. 89 mm SVL) from the Sierra de Manantlán, Jalisco, Mexico.

between pore series. The dorsal pattern of the holotype (overall pale brownish body with slightly darker patternless head, and only dim crossbands on the back) is illustrated in Fig. 5.

Etymology. The subspecies (and common) name is from the Greek *amydros* (*amydr-*, indistinct, dim, obscure) in allusion to the indistinct or disrupted (or absent) crossbanded pattern on the body.

Recognition. A subspecies of *Sceloporus poinsettii* having combination of: (1) top of head pale to dark brownish (or near black) and usually patternless, (2) black collar 2 to 3 scales wide; (3) dorsum in adults mostly uniformly brownish, or an indistinct pattern of faded crossbands (usually four), or with an irregular pattern of dark marks, (4) large dorsal body scales not more than 33, (5) anterior frontal entire (88%), not longitudinally divided, and (6) high average number of femoral pores (12.2, one leg; 24.4 both legs).

Description. Color and pattern. The top of the head is pale to dark brown or near black and is relatively patternless (occasional indistinct white speckling, TNHC 30477-78); the rear of the head may be noticeably darkened. Prominent pale postocular blotches are absent, at most indistinct, in adults, but may be evident in young (UTEP 6184, RWA 6450, MCZ 136442 [Fig. 5]). The pale intertympanic band is either poorly developed or absent in adults (series of white dots in young); this band may be interrupted by two paravertebral dark streaks (UTEP 6045 [Fig. 5], KU 38098). Pale anterior and posterior borders of the black collar are usually entire, but either may be narrowly interrupted medially (MSB 39949). The collar is relatively narrow (about uniform in width) or with a slightly curved posterior border; the black collar usually is two or three, no more than four, scales wide. Pale brownish bodies may be mostly uniform or have either indistinct crossbands (usually four; distinct in MCZ 136437-38, see Fig. 5), often staggered and broken, or a disrupted, irregular pattern of dark marks and spots (scales may be pale with black edges, TNHC 30477). Body crossbands in young are of variable distinctness (see Fig. 5). Dark scale edges aligned to form longitudinal dark lines on the body are usually lacking (present in MSUM 363, 368, 372 of La Pila series). Specimens of the La Pila series overall are dark dorsally owing to occurrence on black boulders (malpais) of the Guadiana Lava Field (Baker, 1960). The underside of the head in young has a dark blue-barred pattern and midventral pale streak (may be slightly faded). Large males (MCZ 136436, about 122 mm SVL, Fig. 5) acquire uniformly blue throats and dark pigment midventrally between blue, black-bordered belly patches. The eye rim of at least some large individuals is reddish in life.

Scutellation. Scales of the divided supraoculars are subequal in size or the scales of the inner (medial) row are larger than those of the outer (lateral) row. Scales of the posterior frontal-frontoparietal area are often not irregularly subdivided. The mean number of dorsal scales is 28.9 (26-33, n = 80), midbody scales 35.8 (32-39, n = 77), femoral pores 24.4 (19-30, n = 79, both legs) or 12.2 (9-16, n = 159, one leg), and scales between femoral pore series 8.9 (6-12, n = 74). Canthals (each side of head, n = 152) are usually two (83%), occurring in combinations (both sides of head, n = 76) of 1-1 (12%), 1-2

(10%), and 2-2 (78%). Preocular scales (each side of head, n = 152) are most often one (81%) rather than two (19%), with combinations (both sides of head, n = 76) of 1-1 (74%), 1-2 (14%), and 2-2 (12%). The anterior frontal is entire, not longitudinally divided (88%, n = 78). The prefrontals (n = 76) are in medial contact (88%) or are separated (12%, by an azygous scale in four of nine). The anteriormost sublabial scale (outer row) and the mental are usually separated (each side of head, 87%, n = 150). The largest male is 123 mm (BYU 13857), largest female 115 mm SVL (UCM 12935).

Distribution. *Sceloporus p. amydrus* has a rather restricted geographic range in

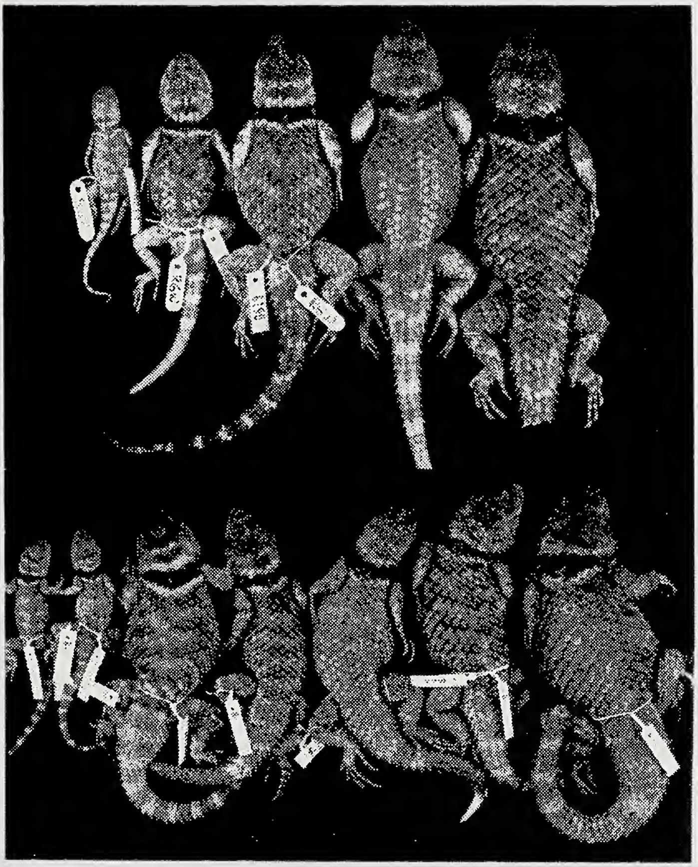

Fig. 5. Dorsal patterns of *Sceloporus p. amydrus* (all Zacatecas, México). **Upper**, left to right: UTEP 6214, male, 40 mm SVL (S Gonzales Ortega); UTEP 6045, female, 67 mm SVL (NW Fresnillo); UTEP 6190, holotype, female, 86 mm SVL (S Gonzales Ortega); RWA 5228 [n = 7], male, 92 mm SVL and female, 110 mm SVL (ESE El Sauz). **Lower**, left to right (all MCZ): 136442, male, 50 mm SVL (WNW Fresnillo); 136441, female, 50 mm SVL (WNW Fresnillo); 136437, male, 96 mm SVL (El Arenal); 136434, female, 90 mm SVL (W Fresnillo); 136431, female, 97 mm SVL (W Fresnillo); 136432, female, 100 mm SVL (W Fresnillo); 136436, male, 122 mm SVL (El Arenal).

western Zacatecas and adjacent southeastern Durango. The eastern terminus of range may have been influenced by the historical barrier of the large water-volumed, north-south flowing Río Aguanaval (see Morphological Intermediate Variants). Aside from the slightly hilly, black-bouldered malpais area near La Pila, Durango, individuals occur among rock outcroppings of low hills (and on rock walls, holotype and paratopotype) that may be landscaped in pinón pine, juniper, and oak. Elevations are rather high ranging from near 1906 m (6253 ft) at La Pila and 2001 m (6565 ft) at Francisco I Madero, Durango to 2438 m (8000 ft) recorded at the collecting site of El Calabazal, Zacatecas.

***Sceloporus poinsettii axtelli* subsp. nov.**

Texas Crevice Spiny Lizard

Sceloporus poinsettii axtelli. Holotype, UTEP 10613, male in fluid, 21.5 road miles south (St. Hwy 118) Alpine, Brewster County, Texas (road cut, dark igneous outcrops), obtained 17 May 1985 by Jerry D. Johnson (original field number, CSL [Carl S. Lieb] 7177). The holotype and two topotypes (UTEP 10612, male and UTEP 10614, female, same collection data) are vouchers for tissue samples (heart, liver, muscle, CSL). The type material also includes UTEP 10615 (n = 19, born 10 July 1985), young of UTEP 10614, 111 mm SVL.

Description of holotype. Male, 110 mm SVL; dorsal body scales 35 and scales around midbody 41; anterior frontal longitudinally divided; posterior frontal fragmented into three scales with frontoparietals 1-1 separated by an azygous scale; prefrontals in medial contact; canthals 2-2, loreals 1-1, preoculars 2-2 (3, irregular on left side), and anteriormost sublabial not touching mental on either side; femoral pores 11-11 with 10 scales between pore series. The dorsal pattern (Fig. 6) has indistinct crossbands but dark vertebral blotches on the back and the characteristic head patterns (dark postocular streaks and X-shaped blotch). The belly has a midventral slit and the entire right leg (right foot missing) is internally excised (skin only).

Etymology. The subspecies name honors Ralph W. Axtell, long-time summer field companion since the early 1960s, who provided most vehicular transportation, who donated many specimens of *Sceloporus poinsettii* (UTEP) from his private collection, and whose industry has contributed to our knowledge of Texas lizards.

Recognition. A subspecies of *Sceloporus poinsettii* having a combination of: (1) enlarged pale blotch-like area behind each eye above dark postocular stripe, (2) dark cruciform (X-shaped) blotch on rear of head (sides indented by pale postocular blotches), (3) sexual pattern dimorphism on body (but variable), adult females crossbanded and males with dark vertebral blotches, and (4) dorsal body scales usually about 33-34 (not less than 30, usually less than 36).

Description. Color and pattern. *Sceloporus poinsettii axtelli* has a contrasting rear-of-head pattern of dark, narrow postocular stripes, enlarged pale postocular blotch-like areas, and a dark cruciform occipital blotch. The pale (whitish) postocular blotches (above the dark postocular stripes) that form the lateral indentations of the dark cruciform

or X-shaped occipital blotch, are usually open posteriorly separating (may be only indistinctly connected) the dark postocular stripes and dark X-shaped blotch. The top of the head may be mostly uniformly pale brown with pale and dark shadings, or have darkened supraocular areas. The dark, cruciform blotch may be either interrupted medially or disrupted with pale areas. The moderately distinct, pale intertympanic band, usually complete, may be interrupted by paravertebral black streaks (UTEP 8879, 13735, Fig. 6). The black collar has relatively straight borders, is about three or four scales wide, and each of the whitish borders is about two scales wide. The whitish anterior and posterior borders of the black collar are usually entire, but either may be narrowly interrupted medially by black streaks. The anterior pale border of the black collar may be interrupted by a pair of paravertebral dark streaks or by a pair of lateral dark streaks (that connect black collar and dark nape blotch). Body patterns are variable, usually with three (or four) crossbands that may be faded, or have the pigment restricted to dark vertebral blotches (with interspaces of whitish spots, single or paired); crossbands may be of mostly solid color or have some scales pale with black edges. The back may have narrow black longitudinal lines (scale edges black). Although variable, dorsal body patterns of adults (at least exceeding 100 mm SVL) tend to segregate by sex; males have the lateral parts of the crossbands faded with prominent dark (black) vertebral blotches separated by white spots or bars, whereas females have mostly crossbanded patterns but often with vertebral areas also blackened (compare these sexual differences in pattern in Fig. 6). In this regard, all three specimens illustrated in Webb (1988, Fig. 2) from the Río San Pedro (= Devils River) are males. Newborn young have brownish crossbands. The juvenile pattern on the underside of the head is reduced and indistinct (may be mostly absent), consisting of a fine blue and white marbling, and may have a semblance of a pale midventral streak. Descriptive aspects of new-born Texas young are in Ramsey and Donlon (1949) and Axtell (1950). Photographs of some Texas specimens are in Smith (1946:199, Pl. 42), Greene (1970, neonate), Garrett and Barker (1987:Pl. 41, color), and Vermersch (1992, color Pl.).

Scutellation. The supraoculars are divided, but the medial row of scales may be larger than those of the lateral row, and scales of the frontoparietal-posterior frontal region are frequently irregular (Fig. 1B). Scale irregularity is extreme for the species in a male *S. p. axtelli* (UTEP 14655) with some named head scales unrecognizable (see species account). The mean number of dorsal scales is 33.6 (30-37, 98% 36 or less, n = 307), midbody scales 38.0 (33-43, n = 237), femoral pores 20.5 (16-30, n = 280, both legs) or 10.3 (7-16, n = 577, one leg), and scales between femoral pore series 10.3 (7-13, n = 275). Canthal scales (each side of head, n = 580) are more frequently two (67%) than one (33%), occurring in combinations (both sides of head, n = 290) of 1-1 (28%), 1-2 (9%), and 2-2 (63%). Preocular scales (each side of head, n = 584) are more frequently two (62%) than one (38%), with combinations (both sides of head, n = 292) of 1-1 (32%), 1-2 (12%), and 2-2 (56%). The anterior frontal (n = 292) is entire (54%) or longitudinally divided (46%, irregular on occasion). The prefrontals (n = 286) are usually in medial contact (80%, rarely partly separated by small azygous scale) or are separated (20%, most often by a large azygous scale). The separation of the anteriormost sublabial scale (outer row) and the mental (each side of head, n = 484) is more frequent (84%) than

contact of those two scales (16%). The largest male (MSB 21272) is 132 mm, the largest female (ASNHC 1018) 120 mm SVL; Ballinger (1973:273) recorded 128 mm SVL for a Texas female.

Comparison of the three largest geographically restricted samples indicates variation in some features of scutellation. The westernmost sample consists of 66 specimens (all UTEP) from the Hueco Mountains, vicinity of Hueco Tanks State Park, El Paso County, Texas. The other Texas sample of 57 specimens (all ASNHC) is east of the Pecos River from 7 mi SW and 11-15 mi NW Mertzon, Irion County (Ballinger, 1973). The third

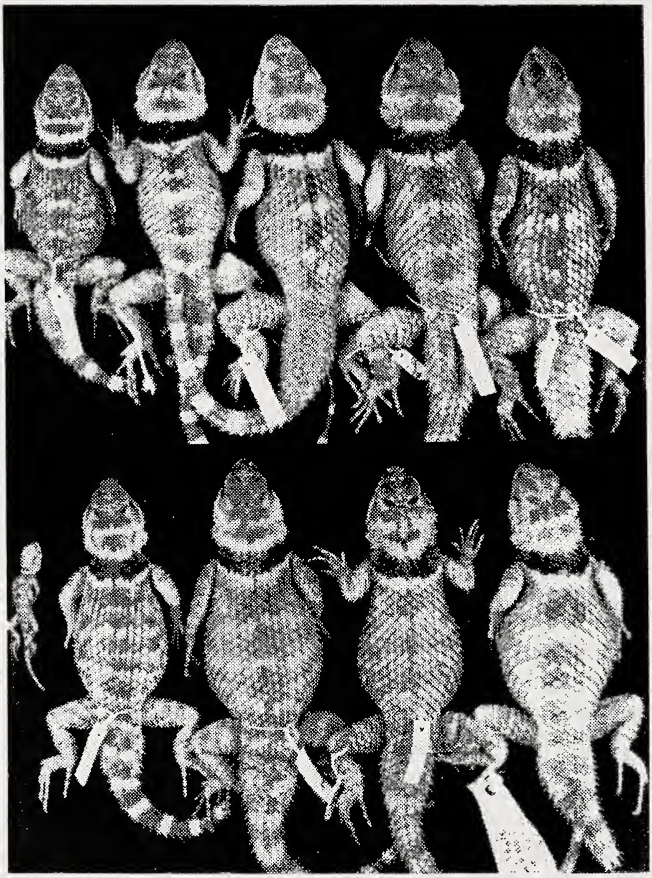

Fig. 6. Dorsal patterns of *Sceloporus p. axtelli*. **Upper**, left to right (all males): UTEP 11524, 82 mm SVL (Texas, Hudspeth Co.); UTEP 13735, 100 mm SVL (Texas, Culberson Co.); UTEP 12309, 109 mm SVL (New Mexico, Otero Co.); UTEP 10613, holotype,110 mm SVL (Texas, Brewster Co.); UTEP 9220, 111 mm SVL (Chihuahua, S La Mula). **Lower**, left to right (all females): UTEP 6638, hatchling, 30 mm SVL (Chihuahua, NNE Samalayuca); UTEP 11510, 95 mm SVL (New Mexico, Otero Co.); UTEP 11525, 107 mm SVL (Texas, Reeves Co.); UTEP 8879, 106 mm SVL (Texas, Bexar, Co.); UTEP 2855, 107 mm SVL (Texas, El Paso Co.).

smaller sample of 27 specimens (all UTEP) is from across the Río Grande in the Sierra Jardin in northern Coahuila, México. The number of dorsal scales, midbody scales, and scales between pore series do not vary among these samples. Lizards of the Sierra Jardin population average more femoral pores (22.9, 20-30, n = 24, both legs; 11.4, 10-16, n = 51, each leg) than either the Hueco Tanks (18.9, 16-24, n = 65, both legs; 9.4, 7-12, n = 131, each leg) or the Mertzon (20.0, 17-24, n = 56, both legs; 10.0, 8-12, n = 113, each leg) populations. Respective values for the Hueco Tanks, Sierra Jardin, and Mertzon populations for the other somewhat variable characters are: anterior half of frontal entire (57%, 54%, 67%), prefrontals in medial contact (79%, 92%, 95%), canthals either one (54%, 23%, 5%) or two (46%, 77%, 95%), preoculars either one (30%, 39%, 51%) or two (70%, 61%, 49%), and sublabial and mental usually separated (100%, 85%, 53%). The high frequency of contact of the sublabial and mental scales in the Mertzon sample (47%) is matched only in *S. p. poinsettii* (especially the non-Hidalgo County sample, 53%).

Distribution. *Sceloporus p. axtelli* occurs in southeastern New Mexico, Trans-Pecos and central Texas, and adjacent parts of northeastern Chihuahua and northern Coahuila.

All records of occurrence in New Mexico are west of the Pecos River and east of the Río Grande in Lincoln, Otero, Chaves and Eddy counties from the Sacramento and northern Hueco mountains east through the Cornudas and Guadalupe mountains (Degenhardt et al., 1996:175, map). *Sceloporus poinsettii* does not occur in the Franklin-Organ-San Andreas Mountain chain immediately to the west of the Hueco and Sacramento mountains in Texas and New Mexico (see account of *S. p. poinsettii*).

The distribution in Texas is detailed by Axtell (1987) with records of occurrence generally on the Edwards Plateau and extending westward as far as the Hueco Mountains in El Paso and Hudspeth counties in extreme west Texas. The southern rim of the Edwards Plateau limits the southward distribution of the species in Texas. In northeastern Chihuahua, *S. poinsettii* is absent in the Sierra Juarez (just south of the Franklin Mountains and El Paso, Texas) and the Sierra Samalayuca to the west of Samalayuca; however, *S. p. axtelli* occurs in the Sierra del Presidio (just east Samalayuca), extending southeastward, vicinity of Chilicote and La Mula, and east into the Sierra de Hechiceros. In adjacent northern Coahuila, *S. p. axtelli* occurs in the Sierra de la Encantada and southeast to the vicinity of Múzquiz and Sabinas, and northeast into the Lomero de Peyotes range, southwest of Villa Unión. Specimens from near Músquiz are somewhat reluctantly assigned to *S. p. axtelli*; dorsal patterns are suggestive of intergrade specimens to the south (see Morphological Intermediate Variants).

Sceloporus poinsettii polylepis Smith and Chrapliwy

Smallscale Crevice Spiny Lizard

Sceloporus poinsetti polylepis Smith and Chrapliwy, 1958:269. Holotype, UIMNH 21464, adult male in fluid, from 18 miles north (by one-lane dirt trail that generally paralleled railroad track, Hobart M. Smith, in litt., 1 February 1994) of Escalón,

Chihuahua, ca. 1501 m (4925 ft); obtained 25 June 1934 by David H. Dunkle and Hobart M. Smith. Two topotypes (UIMNH 21465-66) have the same collection data as the holotype. The holotype (examined by author), a male of about 69-72 mm SVL, having small dorsal scales (41-42), dark postocular stripes, pale postocular blotches and dark cruciform (X-shaped) occipital blotch, and a longitudinally divided anterior frontal, is regarded as a morphological intermediate variant (intergrade). See introductory comments.

Recognition. A subspecies of *Sceloporus poinsettii* recognized by combination of: (1) black rear of head with whitish marks; black continuous behind distinct, short, whitish postocular bar (no distinct dark cruciform blotch); (2) sexual pattern dimorphism on body, adult females usually with irregular pattern of pale and dark marks and adult males with black vertebral blotches separated by paired white spots; (3) small dorsal body scales, 37.5 (33-41, 93% 35 or more), (4) anterior frontal entire (90%), not longitudinally divided; (5) maximal SVL not exceeding 100 mm SVL.

Description. Color and pattern.—The top of the head and neck are dark, near black thus providing contrasting whitish, narrow and short postocular bars, and nape spotting, the latter usually arranged to form an intertympanic band. The black rear of head is continuous behind the white postocular bars. The black side of the head is sharply demarcated from the pale supralabial area below. A pale dot often occurs on each parietal and the interparietal. The collar is three to five black scales wide, and may have a blue scale within the black collar above the shoulder. The pale anterior and posterior borders of the black collar are about two scales wide, and both are usually narrowly interrupted medially (either pale border may be entire); the anterior border may be broken into a series of spots with the lateralmost spots often having short, lateral anterior extensions. Dorsal body patterns are usually markedly different in males and females (Fig. 7). Males have black vertebral blotches on the body that decrease in size and fade posteriorly; these blotches are separated by whitish, often paired spots that coalesce and likewise become less distinct posteriorly. The largest males may be mostly uniform dorsally or have only an anterior indication of black blotches (UTEP 3702, Fig. 7; RWA 5731-32). Sides of the body are a patternless pale yellowish (usually) or orangish. A small male of 62 mm SVL (UTEP 3614) is not distinctly blotched (Fig. 7) unlike a similar-sized male (UTEP 8913, 62 mm SVL). Dorsal body patterns in females are not distinctly crossbanded, having a variable mixture of scattered pale dots and dark markings (Fig. 7). Some females (no enlarged pair of postanal scales) have dorsal body patterns similar to that in males (UTEP 6224, Fig. 7, and UTEP 6085); UTEP 6085 has faded crossbar-like lateral extensions of the black vertebral blotches. Dark longitudinal lines (scale edges) may occur on the body (Fig. 7, UTEP 3614-15). The dorsal, dark crossbanded tail pattern is of variable distinctness, contrasting or not (Fig. 7); the tail may have several narrow crossbands (UTEP 3614, Fig. 7) or is mostly dark with pale flecks (UTEP 3619, 3622). Tails usually lack any ventral pattern, or faded, dark crossbands may occur on the distal part of the tail (RWA 6172, 6194; UTEP 3633, 4327, all males). Ventral surfaces in adult males are pale yellow except for the uniformly blue underside of head (chin region paler), varying degrees of black on chest (may be complete across throat), and blue, black-bordered belly patches; black is extensive in the groin-preanal areas, and may interconnect belly patches in places. Large females have bluish throats (usually with indistinct pale mottling) and blue, dark-

bordered belly patches, but colors are not as bright as in males. Juveniles (UTEP 8911, male 32 mm SVL, and UTEP 8912, female 30 mm SVL) have pale postocular bars and a few pale nape scales, pale blue-gray and white mottled throats, and faded blue belly patches; bodies, not noticeably crossbanded or blotched, are mostly patternless with only scattered pale scales and some scattered dark marks.

Scutellation. The supraoculars are divided; the scales of the medial and lateral rows generally are subequal in size, but scales of the medial row may be somewhat larger than those of the lateral row. The posterior dorsal head scales usually are symmetrically

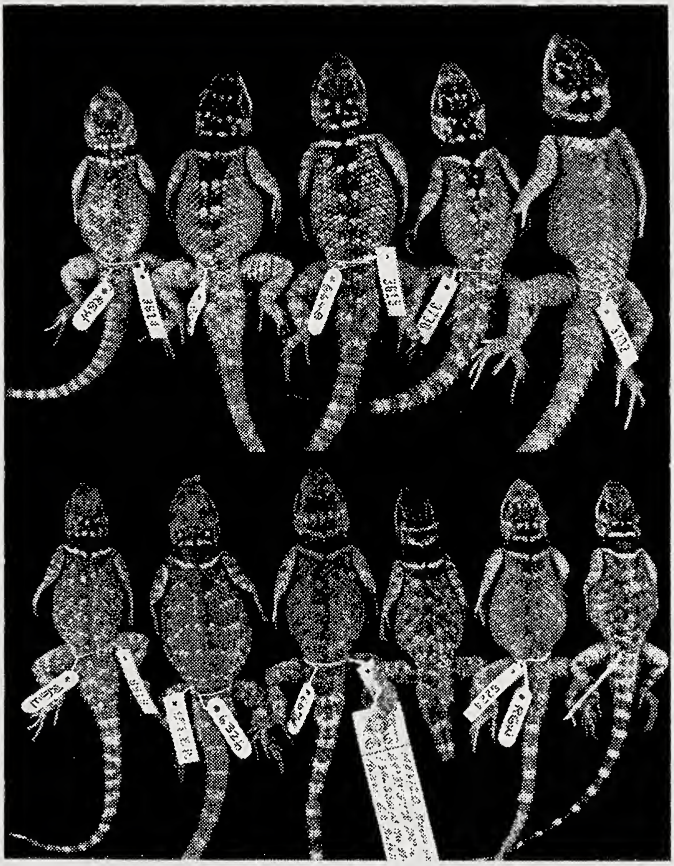

Fig. 7. Dorsal patterns of *Sceloporus p. polylepis*. **Upper**, left to right (all males): UTEP 3614, SVL 62 mm (Zacatecas, W La Presa de Junco); UTEP 8916, SVL 73 mm (Zacatecas, SW San Tiburcio); UTEP 3615, SVL 77 mm (Zacatecas, SW San Tiburcio); UTEP 3730, SVL 76 mm (San Luis Potosí, Huertecillas); UTEP 3702, SVL 91 mm (San Luis Potosí, San Antonio). **Lower**, left to right (all females): UTEP 8919, SVL 61 mm (Zacatecas, SW San Tiburcio); UTEP 8914, SVL 74 mm (Zacatecas, SW San Tiburcio); UTEP 3633, SVL 71 mm (San Luis Potosí, San Antonio); RWA 6161, SVL 66 mm (Nuevo León, San Jose de las Raices); UTEP 6224, SVL 66 mm (Nuevo León, NE Los Medina); UTEP 4327, SVL 60 mm (Nuevo León, NNW Santa Rita).

arranged, not irregularly subdivided; the posterior frontal is entire (rarely subdivided, UTEP 8913, 18917, 3632), and the frontoparietals are usually 1-1 and separated by an azygous scale (rarely frontoparietals otherwise separated or touching medially). The mean number of dorsal scales is 37.5 (33-41, n = 42, 93% 35 or more), scales around midbody 40.7 (36-47, n = 42), femoral pores 21.2 (16-26, n = 40, both legs) and 10.6 (8-13, n = 82, one leg), and scales between pore series 12.2 (9-17, n = 40). Canthals usually number two (99%), and loreals one (93%). Preoculars (each side of head, n = 84) are usually one (88%), but occasionally two (7%) or three (5%). The anterior frontal usually is entire (90%, n = 41), the prefrontals in contact (93%, n = 41), and the anteriormost sublabial separated from the mental (96%, n = 84). The largest male is 91 mm SVL (UTEP 3702, Fig. 7) and female 80 mm SVL (UTEP 6085).

Distribution. *Sceloporus poinsettii polylepis* occurs in northeastern Zacatecas (south of the Sierra el Mascarón [Concepción del Oro]) and eastward through northern San Luis Potosí into adjacent Nuevo León (north to vicinity San Jose de las Raices).

The general habitat is a high desert grassland or scrubland with scattered igneous or limestone rock outcroppings of low hills, with the elevation (recorded in field at only two sites) about 1950 and 1981 m (6400-6500 ft). Dominant vegetation associated with the flat grassland or foothills at most places includes arborescent yuccas, magueys, cholla, nopal, catclaw, lechuguilla, and terrestrial bromeliads. Although lizards may occur on large igneous outcrops, many were associated with inconspicuous, small limestone ridges of limited extent that provided suitable rock-crevice concealment, a microhabitat that perhaps correlates with the small adult size of *S. p. polylepis*. Lizards were taken in the sparse rocky habitat depicted in the background of the pond-habitat photo in Webb (2004, Fig. 2, 15 road mi SW San Tiburcio, Zacatecas).

Morphological Intermediate Variants

Many individuals have variable pattern and scutellation features that are not consistent with the combination of recognition features of the five subspecies; these individuals, thus intermediate morphologically, generally occur in intervening geographic regions and are hereafter referred to as "variants" or "intergrades." The somewhat arbitrary allocation of some specimens does not alter the overall geographic integrity of recognizable populations. These specimens are collectively listed in the Appendix. Representative individuals and populations are discussed below.

Populations of *S. poinsettii* in the high forested parts of the Sierra Madre Occidental in most of Chihuahua and adjacent eastern Sonora are judged to be intermediate between *S. p. poinsettii* to the north (western New Mexico) and *S. p. macrolepis* to the south (southern Chihuahua and Durango). Individuals generally have dark, unmarked heads and broad dark crossbands on the body, which are pattern features of *S. p. macrolepis*, whereas the slightly smaller dorsal scales and high frequency of a longitudinally divided anterior frontal are features not unlike those of *S. p. poinsettii*; one of these specimens (UTEP 2050, Yepómera, Chihuahua) is illustrated in Fig. 8. Large adults tend to have black longitudinal lines on the back, a pattern feature that occurs in both *S. p. poinsettii*

and *S. p. macrolepis*. Lemos-Espinal et al. (2002:165, presumably western Chihuahua specimens) reported broad orange streaks on the sides of the body (axilla to groin) in both sexes, perhaps an intensification of known pale orange body scales in *S. p. macrolepis* and the pale orange sides of the body in *S. p. poinsettii*. North-south geographic variation in four scutellation features also indicates the overall intermediate status of the variant population in northern Chihuahua. This variation is further highlighted if the two geographic segments of *S. p. poinsettii* in New Mexico are treated separately (see descriptive account of that subspecies). Dorsal scales are largest in the southernmost population (*S. p. macrolepis,* 28.6, 25-31, n = 97) and are only slightly smaller in those in central-northern Chihuahua (32.9, 28-38, n = 105), and about the same in *S. p. poinsettii* (31.9, 29-35, n = 202). The diagnostic high frequency of an entire anterior frontal in *S. p. macrolepis* (93%, n = 98) shifts rather abruptly with the Chihuahuan intergrades and *S. p. poinsettii* having about the same high frequency, respectively 96% (n = 104) and 98% (n = 205), of a longitudinally divided anterior frontal. Corresponding south to north changes occur in regard to contact or separation of the sublabial and mental (separated 94% [n = 112] in *S. p. macrolepis*, 77% [n = 26] in Chihuahuan intergrades, and 56.5% [n = 200] in *S. p. poinsettii*) and the prefrontals (contact frequency decreasing, respectively, from 89% [n = 74] to 65% [n = 72] and 47% [n = 195]). However, the *macrolepis* x *poinsettii* sample with about the same frequency of one (46%) or two (54%) preoculars (n = 142) interrupts this geographic trend with a high frequence of one preocular in both *S. p. macrolepis* (70%, n = 148) and *S. p. poinsettii* (95%, n = 408).

Individuals occurring in the foothills of the Sierra Madre Occidental, and in the grasslands throughout central Chihuahua south into Durango are regarded as variants. In Chihuahua, southeast of Nuevo Casas Grandes, a large male (UTEP 14585) has broad body bands most like *S. p. macrolepis* and a dark, white-spotted head similar to that of *S. p. poinsettii*. Farther east in grassland areas dorsal patterns are similar to *S. p. poinsettii* (USNM 104713-14, Progreso near Río Santa Maria; BYU 15334, UTEP 14584, vicinity Ricardo Flores Magón; UTEP 14586, just northeast of El Sueco); the top of the head overall is black (indistinct pale spots) and the body bands are mostly solid black in USNM 104713 (suggestive of *S. p. macrolepis*), otherwise head patterns (dark postocular bars and cruciform blotches) tend toward *S. p. axtelli*, especially that of UTEP 14586. Another lizard from a mountainous area west of Bella Vista, 2020 m (6625 ft) northwest of Cd. Chihuahua (UTEP 8825, Fig. 8) has somewhat pale-streaked crossbands as occurs in *S. p. poinsettii*, but dark pigment is coalesced into vertebral blotches (unlike *S. p. poinsettii*) as occurs in *S. p. axtelli*. All six lizards from near El Tigre, west of Camargo, Chihuahua (UTEP 3587-92) have dorsal patterns (although somewhat variable) similar to that of *S. p. poinsettii* (black longitudinal lines on back, but crossbands lacking) and show varying distinctness of the dark cruciform blotch characteristic of *S. p. axtelli* (UTEP 3587 with this head pattern illustrated in Fig. 8). A color photo (No. 62) of a south-central Chihuahuan specimen (Ejido Mesa de Angostadero) is in Lemos-Espinal et al. (2004c:61).

In desert areas northeast of Cd. Chihuahua, specimens indicate intergradation between *S. p. axtelli* and *S. p. polylepis*. A series of seven (UBIPRO 4283-89) from Cerros Tres Castillos have variable dorsal patterns, but large dorsal scales (32.7, 31-34) not dif-

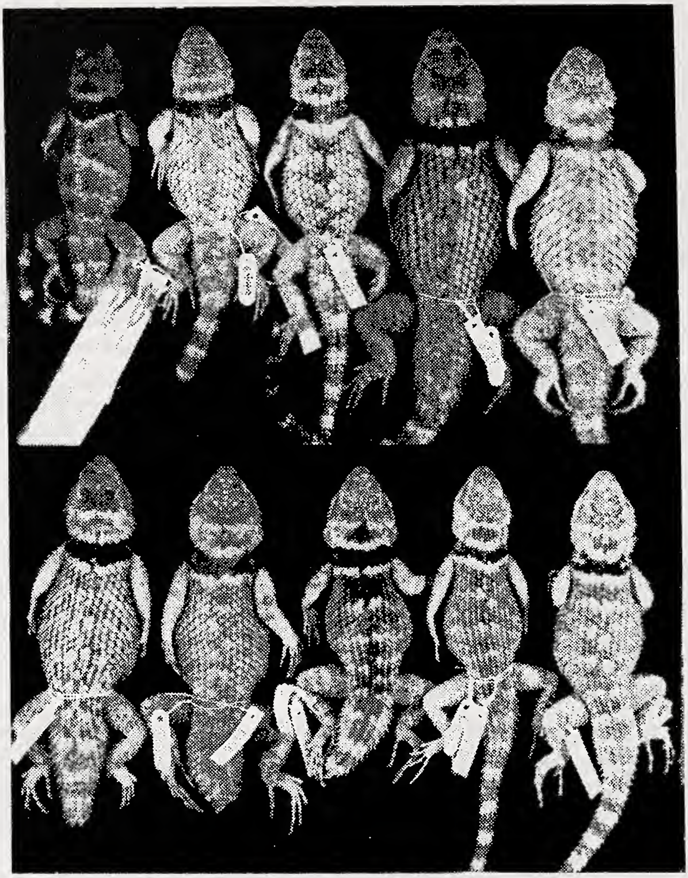

Fig. 8. Dorsal patterns of morphological intermediate variants of *Sceloporus poinsettii*. **Upper**, left to right: UTEP 2050, female, 74 mm SVL (Chihuahua, Yepómera); UTEP 6216, male, 80 mm SVL (Chihuahua, SW Buenaventura); UTEP 8825, female, 84 mm SVL (Chihuahua, W Bella Vista); UTEP 3587, male, 106 mm SVL (Chihuahua, near El Tigre, W Camargo); UTEP 3718, female, 102 mm SVL (Durango, El Palmito). **Lower**, left to right: UTEP 3719, female, 99 mm SVL (Durango, W Rancho Tres Hermanos); UTEP 6180, male, 95 mm SVL (Durango, N Pedriceña); CM 59720, male, 83 mm SVL (Coahuila, Cuesta del Gallo); UTEP 9203, female, 80 mm SVL (Coahuila, W side Sierra San Marcos); CM 43037, male, 91 mm SVL (Coahuila, N Cuatro Cienegas).

ferent from *axtelli*; the anterior frontal is divided in 6 of 7 (not divided in *polylepis*, 90%). In 12 specimens from Cerros Santa Anita (UBIPRO 4301-12), dorsal patterns are not definitive, and relatively small dorsal scales (35.9, 33-38) and small maximal size (female, 105 mm SVL) suggest intermediacy with *S. p. polylepis*. These UBIPRO specimens are mentioned in Lemos-Espinal et al. (2000:185).

In Durango, specimens show an amalgamation of features of *S. p. macrolepis* to the west, *S. p. polylepis* to the east, and *S. p. amydrus* to the south. One lizard from extreme northern Durango (MSUM 9331, south Las Nieves) has dorsal patterns similar

to *S. p. poinsettii*. The pattern features of MSUM 367 (southwest Vicente Guerrero) and MSUM 4305 (north Mezquital) suggest those of both *S. p. macrolepis* (both with broad, complete, but faded crossbands; top of head near black and black collar especially widened vertebrally in 4305) and *S. p. amydrus* (both overall pale brownish, including top of head of 367). Four specimens (UTEP 6165-68) from Rio Chico, Durango, are all assigned to *S. p. macrolepis*, but one large female has faded broad crossbands (UTEP 6165, Fig. 3); likewise, five specimens (UTEP 6158-62) also from the foothills of the Sierra Madre, 10 miles west of Metates, Durango, are most like *S. p. macrolepis* except an adult male (UTEP 6159, Fig. 3) with an almost patternless back resembling *S. p. amydrus*. Intergradation between *S. p. macrolepis* and *S. p. amydrus* occurs in the vicinity of Cd. Durango (map, Fig. 11). Of four specimens (CAS 95919-22, south of Chalchuites, Zacatecas), the adult (95919) and one of the three hatchlings (95922) have wide black collars and broad crossbands on the body (as in *S. p. macrolepis*).

In desert areas of eastern Durango and Chihuahua, and western Coahuila individuals acquire small scales of *S. p. polylepis* and dark longitudinal lines on the body. In the Cuatro Ciénegas area of Coahuila, lizards are judged to be intermediate between *S. p. polylepis* and (but most like) *S. p. axtelli*. Dorsal patterns include indication of the dark cruciform blotch on rear of head (*axtelli*) and dark vertebral body blotches (both subspecies). Two of these (CM 43037, UTEP 9203) are illustrated in Fig. 8. The mean count of dorsal scales in 24 specimens from the vicinity of Cuatro Ciénegas is 34.1 (32-37, 21% 36 or more), which corresponds to that of *S. p. axtelli* (33.6, 30-37); the anterior frontal is longitudinally divided (87%) more like *S. p. axtelli* (46%) than *S. p. polylepis* (10%). The available specimens (24) suggest a relatively small maximal size (as in *S. p. polylepis*), the largest 99 mm (female) and 107 mm (male) SVL.

A variant female (UTEP 3719, west Rancho Tres Hermanos, Durango, Fig. 8, desert-grassland transition) has 36 dorsal scales and a dorsal body pattern of dark lines and faded crossbands. Lizards from eastern Chihuahua (vicinity La Perla south through the Escalón area) and eastern Durango into extreme southwestern Coahuila and northwestern Zacatecas, and the adjacent panhandle of Durango have small dorsal scales (*S. p. polylepis*) averaging 37.0 (33-43, n = 83), and maximal SVL is relatively small (two largest females 95 mm, three largest males 110, 112, and 115 mm). In 17 near topotypic specimens (including holotype of *S. p. polylepis*) from the vicinity of Escalón, Chihuahua (see Fig. 9, upper), dorsal scales average 38.5 (35-43), the anterior frontal (irregular in two) is divided (75%), and the rear-of-head pattern is variable with some patterns not unlike that of *S. p. polylepis* (UTEP 9234) or suggestive of the dark cruciform blotch of *S. p. axtelli* (UTEP 9231). Dorsal patterns of other specimens are variable, some with longitudinal dark lines and the characteristic black cruciform blotch of *S. p. axtelli* (Fig. 9, lower; also UTEP 6180, Fig. 8); the anterior frontal is longitudinally divided (80%) unlike *S. p. polylepis* (entire, 90%). A color photo (No. 61) of an eastern Chihuahuan specimen ("Rancho El Gatuno") is in Lemos-Espinal et al. (2004c:61). Smith and Chrapliwy (1958) designated some small-scaled specimens from south of the Río Nazas in eastern Durango (Lerdo south to vicinity of Pedriceña) as paratypes of *S. p. polylepis*.

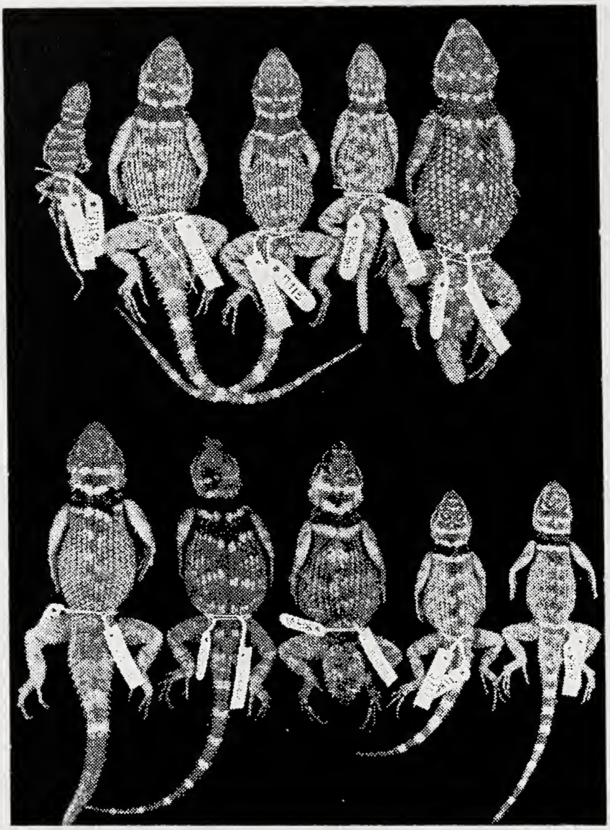

Fig. 9. Dorsal patterns of morphological intermediate variants of *Sceloporus poinsettii*. **Upper**, near topotypic *Sceloporus poinsettii polylepis,* herein as intergrades; all vicinity Escalón, Chihuahua (also UTEP 9224, Lower): UTEP 9223, male, 38 mm SVL; UTEP 9231, male, 72 mm SVL; UTEP 9226, male, 71 mm SVL; UTEP 9233, female, 60 mm SVL; UTEP 9234, female, 90 mm SVL. **Lower**, left to right: UTEP 9186, male, 88 mm SVL (Durango, W La Pendencia, Zacatecas); UTEP 9224, female, 86 mm SVL (Chihuahua, E Escalón); UTEP 9243, female, 89 mm SVL (Durango, SW Picardias); UTEP 9242, male, 64 mm SVL (Durango, SW Picardias); UTEP 9227, male, 65 mm SVL (Coahuila, NW Ahuachila).

In south-central and southeastern Durango, lizards tend to resemble *S. p. amydrus*. A male (UTEP 6670, north Cd. Durango) has pattern features most like *S. p. amydrus*, but differs in having pale postocular blotches (although indistinct) and a high dorsal scale count of 34. To the east, another has faded pattern features (*S. p. amydrus*) but the indistinct pattern of vertebral blotches suggestive of *S. p. polylepis* (UTEP 6193, east Yerbaníz, Fig. 10) and the dorsal scales (34) are smaller than in *S. p. amydrus*. Five specimens from about the same locality in northern Zacatecas (CM 59711-14, UTEP 3629, 18-18.9 miles northeast Nieves) have black-blotched dorsal patterns similar to *S. p. polylepis* (UTEP specimen, Fig. 10, also with dark cruciform head blotch of *axtelli*); two of four counts of

dorsal scales are 38 and 39 (*S. p. polylepis*), whereas the other counts of 34 and 35 are at the lower range of variation. In 12 specimens from northcentral Zacatecas (near Coapas and Tecolotes, RWA 5809, SDSNH 49787-91 and 49793-94, UTEP 14592-94 and 14626) dorsal patterns likewise are generally intermediate between these two subspecies with dorsal scales 36 in one (*polylepis*, SDSNH 49791) but 31-33 in eight (*amydrus*), and an anterior frontal entire in six (*amydrus* and *polylepis*), irregular in one, but longitudinally divided in five of 12.

Lizards from parts of northern Zacatecas, southeastern Coahuila, and adjacent parts of western Nuevo León have characteristics that suggest intergrade status between *S. p. amydrus* and *S. p. axtelli*. Dorsal patterns (both sexes) overall (mostly patternless and narrow black collars) are not unlike that of *S. p. amydrus* (e.g., Coahuilan specimens UTEP 6786, El Chiflon; UTEP 14639-43, Muchachos; USNM 112288-92, near Saltillo; UCM 41492, N Saltillo; and USNM 105786, 105786-93, N Saltillo and Hipolito); another similarly patterned female (UTEP 6066, near Sierra Hermosa, Coahuila, just east Saltillo) is illustrated in Fig. 10. Dorsal patterns of three of five specimens from Cerro La Cuchilla, Coahuila, are most like *amydrus* (USNM 105528, 105530-31), whereas a large male (USNM 105532) has patterns not unlike that of *axtelli*, and a female (USNM 105529) has dark vertebral blotches and a head pattern (faded) as in *axtelli*. Farther east most lizards from one site (Arteaga, USNM 105794-822) generally resemble *S. p. amydrus* in lacking dorsal patterns, but some have faded patterns of *S. p. axtelli* (Fig. 10, lower, USNM 105795, cruciform blotch; USNM 105798, dorsal blotches). Nearby specimens from west of Santa Catarina, Nuevo León (USNM 105827-29) have dark postocular stripes and pale postocular blotches (with variable expression of dark cruciform blotch) as in *S. p. axtelli* and variable body patterns. Some large males from southeastern Coahuila (UTEP 4457) and adjacent Nuevo León (UTEP 6044, Fig. 10), and from Pico de Tiera in northern Zacatecas (UTEP 6197) have near patternless heads (*S. p. amydrus*) combined with body patterns of dark vertebral blotches separated by white scales (*S. p. axtelli*). In Coahuila, variable dorsal patterns suggest intergradation between *S. p. amydrus* and *S. p. axtelli* in specimens from the La Muralla Canyon area (UTEP 4238, 14621-24, 14634-35) and north as far as the Sierra de la Gloria near Monclova and Castaños (RWA 4780, [1]; USNM 46699, UTEP 6195). An adult male from Sierra La Gloria (RWA uncataloged) has head and body patterns of *S. p. axtelli*. Intergradation may occur north as far as the vicinity of Músquiz (RWA 1413-14). Of 25 specimens from west of Bustamante, Nuevo León (just east and south of the Sierra de la Gloria), most are near patternless (resembling UTEP 6066 in Fig. 10) and thus similar to *S. p. amydrus*; one however (EAL 4334, 17.4 miles west Bustamante, Fig. 10) is prominently patterned.

The above-mentioned, generally patternless, lizards (resembling *S. p. amydrus*) from the southeastern part of the range of the species have features of scutellation that also suggest intergradation with *S. p. axtelli*. A comparison of dorsal scale counts from four sizeable samples from restricted geographic areas generally indicates a slight north to south decrease from the higher counts in *S. p. axtelli* (33.6, 30-38, n = 307) to the lowest counts in *S. p. amydrus* (29.2, 27-33, n = 56); a mean of 33.2 (31-37) in the northernmost sample of 25 specimens from 2 to 17.4 miles W to SW Bustamante, Nuevo León (EAL, RWA) decreases to 32.0 (29-35) in 23 specimens from southwest Genéral

Cepéda, Coahuila (KU) and 31.5 (28-35) in 29 specimens from Arteaga, Coahuila (USNM) to 30.8 (29-34) in 23 specimens from farther south near San Antonio de las Alazanas, Coahuila (EAL, RWA). Femoral pores in specimens of these samples have a mean number of about 10, and do not exceed 13 (unlike *S. p. amydrus*, 12.2, 9-16). The Arteaga sample has a high frequency of two preoculars (84%), unlike the other samples (usually one preocular), that perhaps reflects the unusually high frequency of 62% in *S. p. axtelli*.

The intergrade status of lizards (*amydrus* x *axtelli*) in southern and southeastern Coahuila and northern Zacatecas might be explained by the proposed historic barrier of Pleistocene pluvial lakes and large water-volumed route of the old Río Nazas system (Río Nazas-Aguanaval juncture) that flowed eastward perhaps exiting as part of the Río

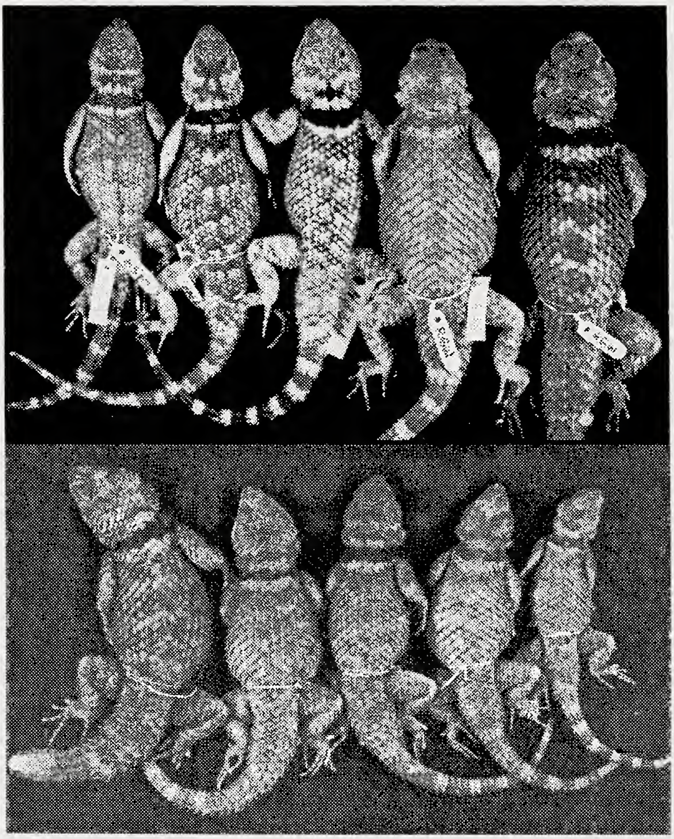

Fig. 10. Dorsal patterns of morphological intermediate variants of *Sceloporus poinsettii*. **Upper**, left to right: UTEP 6193, male, 83 mm SVL (Durango, E Yerbaníz); UTEP 3629, female, 93 mm SVL (Zacatecas, NE Nieves); EAL 4334, male, 91 mm SVL (Nuevo León, W Bustamante); UTEP 6066, female, 105 mm SVL (Coahuila, N Sierra Hermosa); UTEP 6044, male, 115 mm SVL (Nuevo León, SW El Castillo). **Lower** (all from near Arteaga, Coahuila), left to right: USNM 105798, male, 125 mm SVL; USNM 105806, male, 110 mm SVL; USNM 105795, male, 104 mm SVL; USNM 105808, female, 80 mm SVL; USNM 105820, female, 95 mm SVL.

Salado system into the Lower Río Grande; subsequent removal by drier climates then permitted dispersal of *axtelli* south and *amydrus* east and intermixing of the two taxa.

Comparisons

Taxonomic characters of the five recognized subspecies are compared below. See description of the species, *S. poinsettii*, for extremes in some scutellation features. Features of scutellation of no taxonomic importance include number of canthals, loreals, and frontoparietals. The irregular configuration of scales in the posterior frontal-frontoparietal region occurs in varying degrees in all populations, but was not otherwise quantified (subjectively, least in *S. p. macrolepis* and *S. p. polylepis*).

Body size. Four of the five subspecies attain large body size with the largest adults of both sexes well over 100 mm SVL. One subspecies, *S. p. polylepis*, is distinguished by small maximal body size in which individuals are not known to exceed 100 mm SVL. Despite this difference in maximal body size, a sexual size difference is maintained in *S. p. polylepis* (n = 5 largest females, 74.8, 71-80 mm, and males, 81.2, 77-91 mm) with females 92% the size of the males; corresponding data for at least *S. p. poinsettii* (females, 111.2, 108-115 mm; males, 120.4, 115-128 mm) also yield 92%.

Head pattern. The dark top of the head is mostly of uniform color, either blackish or brown (*S. p. macrolepis* and *S. p. amydrus*) or has a rather contrasting pattern of white speckling in *S. p. poinsettii*. Characteristic of *S. p. axtelli* is a distinct pattern of enlarged, whitish postocular blotch-like areas (dark postocular stripes below) that are usually confluent posteriorly with the intertympanic band and indent the sides of a black cruciform blotch on the rear of the head. The rear of the head is black in *S. p. polylepis* with short, whitish postocular bars and other spots.

Body crossbands. Crossbands are dark, broad and of solid color (usually only two or three) in *S. p. macrolepis*, are pale-streaked in *S. p. poinsettii*, are indistinct, absent, or represented only by small, scattered dark marks in *S. p. amydrus*. Crossbands may be faded or irregularly broken and interrupted, or restricted to dark vertebral blotches with intervening white vertebral spots in *S. p. axtelli* and *S. p. polylepis*. In the last-mentioned two subspecies patterns tend to be dimorphic with adult females banded or irregularly patterned and males blotched. Black-edged dorsal body scales aligned to form longitudinal lines, generally present in *S. p. poinsettii*, may occur at least sporadically in other subspecies. The dorsal body pattern is the primary difference distinguishing *S. p. macrolepis* and *S. p. amydrus* (but also average number of femoral pores, see below).

Dorsal scales. Dorsal scales are keeled, but in large individuals scales of the vertebral area covering about six longitudinal rows are smooth or mostly smooth. Numbers of dorsal scales (counted middorsally as near as possible, from enlarged interparietal to level even with rear margin of thigh) geographically segregate into three slightly overlapping groups-large scales in *S. p. macrolepis* (28.6, 25-31, n = 97) and *S. p. amydrus* (28.9, 26-33, n = 80), intermediate-sized scales in *S. p. poinsettii* (31.9, 29-35, 98% 34 or less, n = 202) and *S. p. axtelli* (33.6, 30-37, 98% 36 or less, n = 307), and small scales in *S. p. polylepis* (37.5, 33-41, 93% 35 or more, n = 42). The ranges of variation of the

small-scaled and large-scaled subspecies share only counts of 33.

Midbody scales. Numbers of midbody scales (dorsal and ventral longitudinal rows counted transversely around midbody) correlate with numbers of dorsal scales. Ventral and ventrolateral scales are relatively small so that counts of midbody and dorsal scales are more divergent (mean difference of 6.8 and 6.9 scales) in subspecies with large scales (*S. p. macrolepis*, *S. p. amydrus*) than in the small-scaled *S. p. polylepis* (3.2 scales).

Femoral pores. The number of femoral pores varies from 7 to 16 (one leg) and 14 to 30 (both legs). All subspecies have about the same average number of pores 10.3 to 11.0 (one leg) or 20.5 to 22.0 (both legs), except for the higher average number of pores (12.2, one leg; 24.4, both legs) in *S. p. amydrus*.

Interfemoral pore scales. The minimal number of scales between the femoral pore series does not readily distinguish any subspecies (average 9.4, 7-12, n = 66, *S. p. macrolepis*; 9.6, 7-12, n = 194, *S. p. poinsettii*; 10.3, 7-13, n = 275, *S. p. axtelli*); however, these scales average the most in *S. p. polylepis* (12.2, 9-17, n = 40), and the fewest, correlating with most femoral pores, in *S. p. amydrus* (8.9, 6-12, n = 74).

Preoculars. Two preoculars often occur in *S. p. axtelli* (62%, n = 584), whereas the other four subspecies most often have one (70% or more; 70%, n = 148, *S. p. macrolepis*; 81%, n = 152, *S. p. amydrus*; 95%, n = 408, *S. p. poinsettii*; 88%, n = 84, *S. p. polylepis*).

Anterior frontal. For some reason, the condition of the anterior frontal (entire or divided), unlike other head scalation features, geographically segregates into high frequencies in four of the five subspecies. The anterior part of the transversely divided frontal scale is entire in *S. p. macrolepis* (93%, n = 98), *S. p. amydrus* (88%, n = 78), and *S. p. polylepis* (90%, n = 41), but longitudinally divided in *S. p. poinsettii* (98%, n = 205). The anterior frontal is entire (54%) or longitudinally divided (46%) with about equal frequency in *S. p. axtelli* (n = 292).

Prefrontals. The two prefrontals are usually in broad contact medially in all subspecies (89%, n = 74, *S. p. macrolepis*; 88%, n = 76, *S. p. amydrus*; 80%, n = 286, *S. p. axtelli*; 93%, n = 41, *S. p. polylepis*), except for separation (53%) or contact (47%) with about equal frequency in *S. p. poinsettii* (n = 195).

Sublabial-mental. The anteriormost labiomental (herein termed sublabial) and mental are usually not in contact (postmental touching first infralabial, 94%, n = 112, *S. p. macrolepis*; 87%, n = 150, *S. p. amydrus*; 84%, n = 484, *S. p. axtelli*; 96%, n = 84, *S. p. polylepis*). The highest frequency of contact of these two scales is about 44% (n = 200) in *S. p. poinsettii*, and 47% in the Mertzon sample of *S. p. axtelli* (16% or less in other subspecies and samples).

The two geographically adjacent taxa, *macrolepis* and *amydrus*, differ primarily in dorsal patterns but also in the average number of femoral pores that is higher in *amydrus* (12.2, 9-16, n = 159, one leg; 24.4, 19-30, n = 79, both legs) than in *macrolepis* (10.6, 8-14, n = 152, one leg; 21.3, 16-27, n = 76, both legs); they both occur at the highest elevations and have the largest dorsal scales. Pattern and scalation features show a north-

south geographical transition in the Sierra Madre Occidental between *S. p. poinsettii* (north) and *S. p. macrolepis* (south); geographical variants in central-northern Chihuahua generally retain the dorsal patterns of *macrolepis*, unlike some transitional aspects of head scutellation. The nominotypical subspecies and *S.* p. *axtelli* share in the "intermediate-sized dorsal scales" and have differentiated primarily in head and body pattern (occasional semblance in *S. p. poinsettii* of black cruciform head blotch characteristic of *S. p. axtelli,* see Fig. 2). The two intergrading taxa, *axtelli* and *polylepis*, both share in sexual pattern dimorphism, which seems more discrete in *polylepis.*

Key to Subspecies of *Sceloporus poinsettii*

1A. Dark crossbands on body, usually four and with black-edged pale scales, often tending to form longitudinal dark lines; dorsal body pattern lacking dark vertebral blotches; top of head with prominent white speckling; dorsal scales 34 or less (98%); anterior frontal longitudinally divided (98%). *S. p. poinsettii.*

B. Character combination not as above. .... 2.

2A. Rear of head patterned with distinct white spots or black cruciform blotch; dorsal body pattern may have series of black vertebral blotches; dorsal scales usually more than 30 .... 3.

B. Head of mostly uniform color, lacking any prominent pattern; dorsal body pattern lacking black vertebral blotches; large dorsal scales usually less than 31 (no more than 33) .... 4.

3A. Black postocular stripes and cruciform (X-shaped) blotch on rear of head; dorsal scales usually less than 36 (98%); maximal SVL exceeding 100 mm. *S. p. axtelli.*

B. Rear of head black with whitish spots and short, white, postocular bar (no dark cruciform blotch); dorsal scales usually more than 35 (93%); maximal SVL not exceeding 100 mm. *S. p. polylepis.*

4A. Two broad, dark (unicolor) bands across back (excluding sacral area); black collar often lengthened and curved posteriorly. *S. p. macrolepis.*

B. Body uniformly brownish, or with indistinct crossbands or scattered dark marks; black collar relatively narrow, not noticeably lengthened posteriorly. *S. p. amydrus.*

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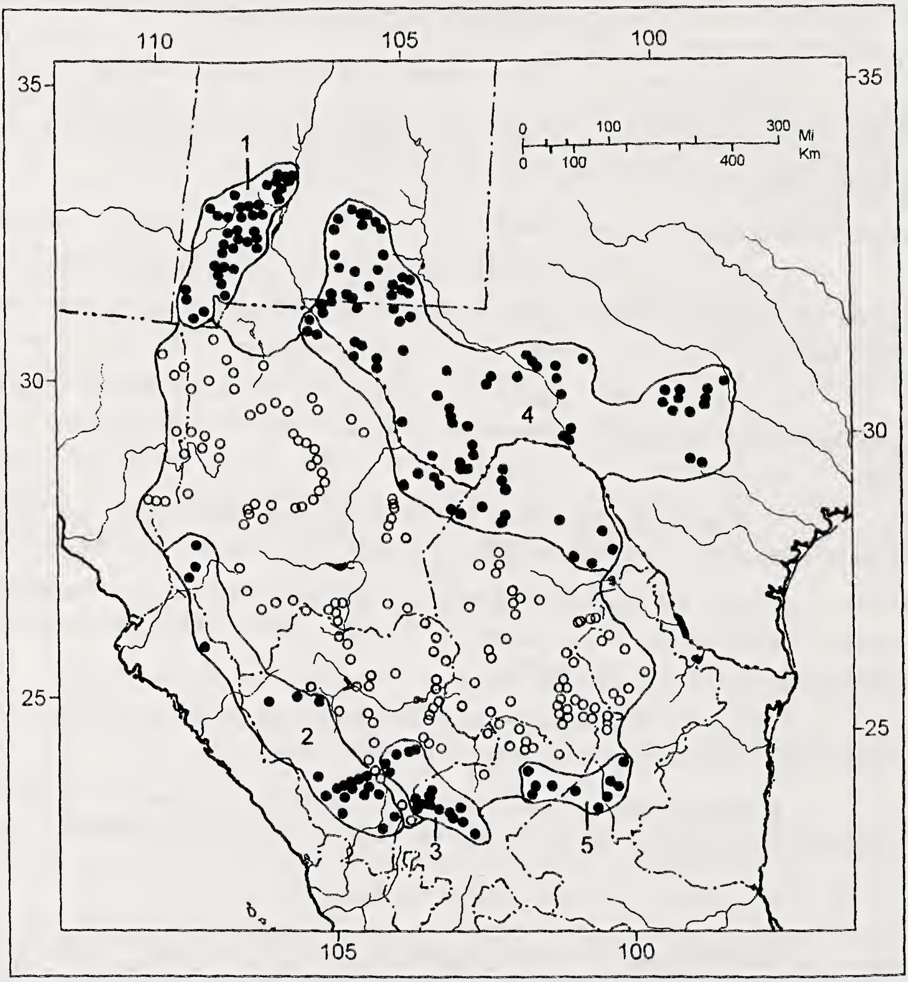

Fig. 11. Distribution of *Sceloporus poinsettii* in New Mexico, Texas and northern Mexico (specimens examined only, many localities share same symbol, see Appendix). Guide to symbols and subspecies: Open circles, morphological intermediate variants. Solid circles, subspecies of *S. poinsettii* (demarcated by solid lines): 1, *S. p. poinsettii*; 2, *S. p. macrolepis* (see text, Distribution, Jalisco specimen); 3, *S. p. amydrus*; 4, *S. p. axtelli*; 5, *S. p. polylepis*.

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Appendix

Localities of museum specimens examined are indicated below and plotted on the distribution map (Fig. 11, excluding some generalized or otherwise imprecise localities). Each map symbol may incorporate closely approximated localities; some localities have been refined with bracketed comments (often coordinates of north latitude and west longitude in anticipation of using [but unsuccessfully] an electronic program to aid in map-plotting). Features of scutellation were not recorded for all examined specimens. "Additional records" includes specimens not examined or for other explained reasons not plotted on the map. Institutional codes identifying museum collections are listed in the previous section, Methods. Distances are cited as originally transcribed (kilometers or miles).

Sceloporus poinsettii poinsettii. **New Mexico**: **Catron County**: Mogollon Creek (T12S, R17W, Sec. 36) [33°13'N, 108°03'W] (NMSU 3689); T12S, R15W, Sec. 3 [33°16'50"N, 108°23'20"W] (NMSU 4111); R15W, T12S, Sec. 18 [33°15'10"N, 108°26'20"W] (NMSU 4112); Black Range, Wall Lake [33°21'N, 108°04'44"W] (MSB 4202-15); 1 mi N (MSB 20898), 2 mi N (MSB 4231), and 3 mi N (St. Hwy 61) Wall Lake (MSB 20902-03); Railroad Canyon [33°33'21"N, 108°07'31"W] (MSB 22348); Gila Cliff Dwelling National Monument [GCDNM, 33°13'38"N, 108°16'18"W] (UAZ 2871); 2.7 km NW GCDNM (MSB 42795); N St Hwy 15, just E GCDNM boundary at T12S, R14W, NW 1/4 Sec. 26 (UTEP 18550); vicinity GCDNM (UAZ 15558); Middle Fork Gila River, 6 mi N T.J. Corral (T12S, R14W, Sec. 33) [not compatible with "T.J. Ruins" ? at 33°13'16"N, 108°14'20"W] (GNHC 13707); West Fork Gila River, 4-6 mi upstream from GCDNM [ca. 33°15'10"N, 108°18'45"W] (MSB 41622); Mogollon Mts, Willow Creek [Campground, 33°24'05"N, 108°34'43"W] (MSB 4233); Mogollon Mts, White Water Canyon [33°21'35"N, 108°03'55"W] (MSB 11460); 15 mi NW Winston, Sierra County (along St. Hwy 59) [ca. 33°29'N, 107°46'10"W] (MSB 13469); near Old Horse Springs (UCM 34131, 34133); 11/2 mi SE Old Horse Springs [33°54'10"N, 108°12'30"W] (UCM 6190-6207); 6 mi WSW Old Horse Springs [33°53'15"N, 108°18'40"W] (UCM 6183-89); 7 mi W Old Horse Springs (UCM 6179-82); 12 mi S Old Horse Springs, Bat Cave, SW corner of San Augustine Plains [33°45'30"N, 108°14'28"W] (UCM 6208, MSB 13470); 12 mi W Old Horse Springs [33°55'50"N, 108°23'30"W] (UCM 11073); 2 mi E Beaverhead [ca. 33°45'23"N, 108°04'50"W] (UCM 6209). **Grant County**: Pinos Altos, 7 mi NE Silver City [32°52'N, 108°13'30"W] (MSB 40944-47, UCM 48193); Little Cherry Creek at St. Hwy 15 (UTEP 1703); Little Cherry Creek, 2.8 mi N (UAZ 15840, 15972-76, 18534, 18972) and 3.8 mi N (UAZ 15554, 15557, 15566) Pinos Altos; 3 and 4 mi N Pinos Altos (GNHC 12452, 13012, 13016); Ben Lily Memorial, 3 mi NW Pinos Altos or ca. 11 mi N Silver City (T16S, R14W, S1/2 Sec. 24) [32°53'52"N, 108°14'42"W] (GNHC 13015, UAZ 25245, UTEP 11870-72); Ben Lily Lake [just W Ben Lily Memorial] (GNHC 12454, 12589), and Cherry Creek, 11.9 mi N Silver City (GNHC 12453); 1/2 mi N (St. Hwy 15) [MSB 23129], 11/2 mi E [MSB 23131], and 2 1/8 mi S [MSB 23130] Cherry Creek Campground [32°54'51"N, 108°13'25"W]; Pinos Altos Road, Silver City (GNHC 12183); East Fork McKnight Canyon [32°56'54"N, 108°08'56'W] (GNHC 12184); Cherry Creek, 1/4 mi N McMillan Campground [32°55'26"N, 108°12'47"W] (GNHC 12738); Silver City [post office, 32°46'12"N, 108°16'47"W] (GNHC 13019, 13814); 1 mi W Silver City (UAZ 25243-44, 25247-48); 1/2, 21/2 [32°48'N, 108°14'50"W], 3, 4, 41/2 [32°49'50"N-108°14'W] and 7 mi N(NE) Silver City [= Pinos Altos] (GNHC 12180, 12182, 12185, 12577-80, 12585, and 12916 at T17S, R14W, Sec. 13); Meadow Creek, NE Silver City (GNHC 12842-43); Cleveland Mine, 51/4 mi N Silver City (T17S, R14W, Sec. 2) [32°51'25"N, 108°15'35"W] (GNHC 12181, 13430); along St. Hwy 15 (= Forest Road 756), 1/8 mi N jct with St. Hwy 35 [33°02'N, 108°13'W] (MSB 23124); Lake Roberts, 16 mi N-6 mi E [air] Silver City (T14S, R13W) [33°02'N, 108°10'W] (MSB 17563-65); Skates Canyon, 7 mi SW Lake Roberts [33°00'44"N, 108°06'23"W] (GNHC 13011); 18 mi SW Silver City, Hwy 90 (101/2 mi E Thompson Canyon) [32°33'N, 108°23'W] (GNHC 13009); 23 mi S Silver City on White Water Road [near 32°31'40"N, 108°05'55"W] (GNHC 13529); 27 mi S Silver City (GNHC 13447); 32 mi SW Silver City, C-Bar Canyon, S end Burro Mts (T21S, R16W, Sec. 13) [32°29'N, 108°26'30"W] (GNHC 13580); 62 mi S Silver City, Burro Cienega Homestead (T23S, R14W, Sec. 7) [32°19'15"N, 108°19'20"W] (GNHC 13597); Mimbres [River] (T15S, R11W, Sec. 31) [32°57'20"N, 108°01'30"W] (GNHC 13013-14, 13018); Fort Bayard [32°47'46"N, 108°08'59"W] (GNHC 12739); 1/2 mi N-2 mi E Bayard (GNHC 13676), and Vanadium, 2 mi E Bayard (T17S, R12W, Sec. 32) [32°46'45"N, 108°07'W] (GNHC 13684); 2 mi W (St. Hwy 90 [= 152]) Sierra-Grant county line [32°54'45"N, 107°47'25"W] (UAZ 40318); Hanover [32°48'48"N, 108°05'26"W] (UCM 13703); 5 mi [N]E (St. Hwy 90 [= 152]) San Lorenzo [32°50'30"N, 107°53'30"W] (MSB 13468); 13 mi NE (St. Hwy 90 [= 152]) San Lorenzo (= 0.6 km N-1 km W Emory Pass at Iron Creek Campground) [32°54'55"N, 107°46'35"W] (RWA); Iron [Creek] Canyon, Black Range (MSB 4235-36); 25.7 road mi [St. Hwy 61] S Wall Lake, Catron County [ca. 33°03'50"N, 108°00'20"W] (MSB 4232); west fork Gila Trail, Gila National Forest (UTEP 495); [Mimbres Mts] Gallinas Canyon, Gila National Forest (T16S, R10W, Sec. 26) [32°53'10"N, 107°51'55"W] (UTEP 14755-58); Gallinas Creek [T17S, R10W, Sec. 10] (MSB 52023); Big Burro Mts, Sawmill Canyon area, just N Forest Road 836 (T20S, R16W, NW1/4 Sec. 14) [32°34'10"N, 108°28'W] (UTEP 11506-08). **Hidalgo County**: 39-40 mi S Hachita (ASNHC 10643, 10701-02, 10704-06, 10727, 11245-51; seemingly same site reported by Ballinger et al., 1977, as 1 mi S Highlonesome Wells, and Ballinger, 1978, as 5 mi N Antelope Wells Mexican border crossing); 31/2 mi W-3.3 mi N [air] Antelope Wells (UTEP 9602-05, 10048, 14580-82; RWA 5 226-27); 3.7 mi W-2.7 mi N [air] Antelope Wells (UTEP 14583); 5 mi W Antelope Wells (NMSU 2101); 41/2 mi N (or NW) Antelope Wells (MVZ 79204-06; NMSU 1715-29; KU 73087-91) [all foregoing localities in Hidalgo County seem to represent the same general collection site, ca. 4 air mi NNW Antelope Wells (near jct with St. Hwy 79), along St. Hwy 81 at T33S, R17W, center Sec. 27 or 31°23'45"N, 108°33'30"W]; 141/2 road mi E (St. Hwy 79) jct with St. Hwy 338 (= ca. 91/2 mi W jct Hwys 79-81) [31°22'15"N, 108°40'30"W] (UTEP 12428-29); 4.9 road mi W (St. Hwy 9) Animas [31°56'35"N, 108°53'W] (UTEP 11155-56); 4.7 mi W (MSB 48828), and 4.4 mi W (St. Hwy 9) Animas (UTEP 13751-52); 5 mi N Animas [32°00'50"N, 108°51'55"W] (Lowe, 1955; Bogert and Degenhardt, 1961, "isolated hill"; AMNH 73740); 4.6 mi S-0.8 mi W Cotton City [32°01'10"N, 108°52'W] (AMNH 109129-31). **Luna County**: Cedar Mts, ca. 9 air mi [N]E Hachita, Grant County (T27S, R13W, SW1/4 Sec's 3 and 15) [31°58'50"N, 108°09'45"W] (UTEP 16398-401, 16410). **Sierra County**: Aldo Leopold Wilderness, South Diamond Creek, ca. 1.0 mi downstream of Burnt Canyon [extreme NW part of county] (MSB 49541-43); 18 mi [N]W Winston (St. Hwy 59) [ca. 33°27'50"N, 107°48'50"W] (UCM 6211-13); Black Range, Taylor Creek, 14 mi W-2 mi N Winston [ca. 33°23'15"N, 107°51'W] (MSB 4228-30); 30 mi NW Chloride (St. Hwy 59) [33°25'10"N, 107°57'50"W] (MSB 17858); Edwards Draw, 3 mi N Winston (St. Hwy 52) [33°23'20"N, 107°40'15"W] (GNHC 13008); [Las] Animas Creek, 30 mi E Silver City (T14S, R9W, Sec. 34) [33°03'N, 107°45'45"W] (GNHC 13708); 0.3 mi W Kingston (St. Hwy 90 = 152) [32°54'50"N, 107°42'15"W] (UTEP 13750); Mimbres Mts, Pierce Canyon, ca. 13 air km NW Lake

Valley (T17S, R8W, Sec. 33) [32°47'20"N, 107°40'05"W] (UTEP 16078); Ladder Ranch, Cross-O Spring, ca. 6 mi N-28 mi W [air] Truth or Consequences [33°12'20.4"N, 107°36'16.4"W or T13S, R7W, SW1/4 Sec. 6] (MSB 60150). **Socorro County**: Magdalena Mts, 3 mi S-4 mi W Socorro [NE corner Socorro Peak, Nogal Canyon, 34°05'50"N, 106°57'55"W] (MSB 4220); Magdalena Mts, 16 mi W-3/4 mi S [air] Socorro, Agua Fria Canyon [34°02'N, 107°14'W] (UTEP 4221); Magdalena Mts, "just above the box" Sawmill Canyon [33°52'30"N, 107°08'W] (MSB 25742); Magdalena Mts, vicinity Water Canyon, 16.1 mi W Socorro (US Hwy 60) [stream crossing hwy, 34°03'30"N, 107°03'30"W] (MSB 11005, 11418, 11523); Magdalena Mts, North Fork Water Canyon (T3S, R3W, SE1/4 Sec. 21) [34°01'55"N, 107°09'30"W] (UTEP 8714; MSB 4222, 5946-47, 6090); Madera Canyon, 11 1/2 mi W-2 1/4 mi N [air] San Antonio (T4S, R2W, Sec. 20) [33°56'55"N, 107°04'10"W] (NMSU 5666); San Mateo Mts (MSB 23384-87); San Mateo Mts, vicinity Bear Trap Canyon, 19 mi W-20 mi S Magdalena [33°35'45"N, 107°35'W, mileages not near Bear Trap Canyon] (MSB 4216-19, 13690-97); San Mateo Mts, Luna Park (MSB 37118); San Mateo Mts, 1/2 mi S Luna Park Campground, 9 mi N Monticello [33°29'45"N, 107°24'53"W] (UCM 32939); San Mateo Mts, Big Rosa Canyon (T5S, R5W, NE1/4 Sec. 6) [33°54'10"N, 107°24'W] (MSB 32128); San Mateo Mts, Springtime Campground [33°34'31"N, 107°24'14"W] (MSB 11010); San Mateo Mts, along Forest Road 549, 2 1/2 and 2.9 road mi SW jct with Forest Road 476 [33°48'30"N, 107°35'15"W] (UTEP 13748-49); San Mateo Mts, canyon on St. Hwy 52, ca. 1 mi S Alamosa Warm Springs [AWS = 3 mi S, 3 mi E Dusty] (MSB 50309).

Additional records. Acceptable localities for some non-examined specimens are: **Catron County**: Mogollon Mts, jct. Snow Canyon and Gillita Creek [near Hwy 149] (Eastern New Mexico Univ. 4136, C.W. Painter, in litt.); Tularosa Mts (LACM 17401-08); 25 mi E Beaverhead [Hwy 59] (UMMZ 85621); 1.7 mi N Wall Lake on St Hwy 61 (CM 48779). **Grant County**: Burro Mts, 2 mi S-13.3 mi E Red Rock (AMNH 84632-35, 109132-33); Big Burro Mts, Gertie Canyon, 2 mi N Peaks (MVZ 7050-54); 4.0 mi E (Hwy 90) San Lorenzo (CM 75495-96); Fort Bayard Horse Training Center, U.S. Forest Service (ASU 4964-66); Fort Bayard Service Wildlife Area, Sec. 24, Ansones Creek (ASU 5901, 5912-13), and Sec. 12, Pear Tree Pasture (ASU 5914); 8 1/2 road mi (Hwy 15) N Silver City (UAZ 50670-72). **Hidalgo County**: T34S, R18W, jct Sec. 4-5 [S1/3], jct Sec. 8-9 [N1/8], and NE1/4 Sec. 13 [S St. Hwy 79, McKinney Flats, W Whitewater Mts] (n = 3; data from C.W. Painter). **Sierra County**: 5.6 mi E (St. Hwy 90) Emory Pass summit (CM 51421); Seventyfour Draw, R10W, T11S (CM 58963).

Smith ("1936"[1938], 1939) first documented records of occurrence in New Mexico. Degenhardt et al. provided a map (1996:175) with spot localities for *S. p. poinsettii* (western New Mexico only); their two southwesternmost symbols in Hidalgo County suggest occurrence in the Peloncillo Mountains. Andrew H. Price (in litt., 10 October 2005) relayed data that those two symbols were based on two, non-examined specimens (both with collection data of Hidalgo County and Peloncillo Mts.), one (MSB 50382) from junction Skeleton and Pine canyons [SE on road from Apache, Hwy 80, Cochise Co., Arizona], the other (Museum of the High Plains, Fort Hays State Univ. 13596 [also recorded as 2814] from Clanton Canyon. One of these specimens (MSB 50382) has been examined and represents *S. jarrovii*, the other (not examined) also likely represents *S. jarrovii*; *S. poinsettii* has not been found in Clanton Canyon [= Clanton Draw, personal visit] where *S. jarrovii* (UTEP 10830) occurs on rocks and *S. clarkii* (UTEP 10834-35) climbs trees. *Sceloporus poinsettii* is not known to occur in the Peloncillo Mountains.

Two specimens (both examined) with questionable locality data are recorded from near Elephant Butte Lake/Dam, Sierra County (BYU 30520, Tanner, 1987:397) and from 5 mi S Hatch, Doña Ana County (CAS 104789); visits to these two general areas have not provided additional specimens. CAS 104789 bears the field tag JRD (James R. Dixon) 7398, who informed the author (in litt., 3 June 2005) that the locality is correct but the species is in error, his field number referring to a DOR snake, *Salvadora hexalepis*. Degenhardt et al. (1996:173) commented on the unacceptable locality of Deming, Luna County (Smith, 1939:225, Acad. Nat. Sci. Philadelphia 21121, not examined). Some other questionable localities are Hachita (USNM 45100-02, not examined, immediate unsuitable habitat; Van Denburgh, 1924; Smith, "1936"[1938], 1939), and Homestead, Separ (GNHC 13010, examined, "sunning on old corral"), which may refer to Burrow Cienega Homestead, Grant County (cited above), but some 10 miles NW Separ. Philip A. Medica (in litt.) noted that MVZ 79204-06, Hidalgo County, collected by him on 10-12 April 1964, are not from the Alamo Hueco Mts (as recorded in the MVZ catalog) but from north of Antelope Wells. Some imprecise (not mapped) localities are "Upper Playas Valley" (MSB 4234, examined), "West Fork of Gila River, 7500" (FMNH 29465-69 and probably 30870 and 30872, examined), and the widespread "Sevilleta National Wildlife Refuge" in Socorro County (MSB 49513, examined).

Despite recorded localities in Arizona (USNM 8493, not examined, Cochise County, Apache, Smith, 1939:225; NMSU 4110, examined, Cochise County, Chiricahua Mts, S Fork, Cave Creek Canyon; and GNHC 13017, 13020-24, examined, Cochise County, "Sierra Vista" [13017, "desert grassland"; others, "no habitat info available"]), *S. poinsettii* is currently considered not to occur in the Peloncillo Mountains or in Arizona.

Sceloporus poinsettii macrolepis. **Mexico**: **Chihuahua**: Cuiteco [27°26'N, 108°00'30"W] (Tanner, 1987, BYU 14273-76, 14287-89); Cerocahui [27°18'N, 108°03'20"W] (Tanner, 1987, BYU 14602, 15667-70); 4.8 mi SE Maguarichic [= Maguarichi, ca. 27°51'30"N, 107°59'35"W] on road to La Laja [Rancho Las Lajas, ca. 27°52'30"N, 107°54'W] (Tanner, 1987, BYU 17070-72); Mojárachic [= Mojárachi, 27°51'N-107°55'W, Lemos-Espinal et al., 2004b:167] (Taylor and Knobloch, 1940 [collections within 10 mile radius, Taylor, 1943:275, footnote]; Smith and Chrapliwy, 1958; UIMNH 21467-69). **Durango**: 10 mi W Durango (Smith and Chrapliwy, 1958; Smith et al., 1964; Webb, 1984; UIMNH 41628); 14 mi WSW Durango (RWA 5232); 15 mi S Durango (UTA 5936-39); 20.1 mi W Durango (RWA 1475-77); 21 mi WSW Durango (MSUM 361); 27 mi S Durango (UCM 20958); 27 mi W Durango (UCM 20948); 28 km S Durango (UTEP 9371-72); 29 1/2 mi S Durango (UTA 4779); 32 1/2 mi W Durango (Tanner, 1987, BYU 14533-35, 15376); 32.6 mi SE Durango near Hwy 23 [road to Mezquital] (UAZ 45507); 34 mi W Durango (UIMNH 41629); 34.6 mi W Durango (UIMNH 6581-82); 42 mi S Durango (UTA 4776-78); El Salto (Smith and Chrapliwy, 1958; Smith et al., 1964; Webb, 1984; UIMNH 35453-56, UTEP 1317); 1 mi E El Salto (MSB 10051-55); 5 mi S El Salto (Webb and Baker, 1962, MSUM); 5 mi W or SW (Hwy 40) El Salto (Smith and Chrapliwy, 1958, UIMNH 76282-87; Smith et al., 1964, UIMNH 41630-36; and RWA 5487); 5 1/2 mi SW El Salto (KU 40413); 5.8 mi WSW El Salto (UAZ 14240, 14933); 6 mi SW El Salto (UAZ 33191); 7.7 mi E El Salto (UAZ 38064-65); 9-10 mi W or SW (Hwy 40) El Salto (Smith and Chrapliwy, 1958, KU 40407-12, 40417-21, 44851; UIMNH 76288); 12 1/2 and 13.9 mi ENE El Salto (UTA 2565, 3566); 15 mi SW El Salto (KU 44852); 6.4-8.1 mi NE El Salto (UIMNH 43295-97); 19 mi E El Salto (RWA [1]); 30 mi E El Salto (KU 40414, 40422); 6 mi SE Llano Grande (Baker and Baker, 1975, UTEP 4831-32, 5435, 6199-6206); 1 mi S Llano Grande (UTA 5958); 1 mi E Llano Grande (UTEP 6207); 1.6 air km S Llano Grande (KU 182633-37); 10 mi E Llano Grande (UTEP 6111-12); E La Ciudad (Tanner, 1987, BYU 41327); W La Ciudad (Tanner, 1987, BYU 41368); 2-3 1/2 mi E La Ciudad (UTEP 14600-05); 4 mi W La Ciudad (Tanner, 1987, BYU 40100); 5 km W La Ciudad (CAS 169767-68); 1/4 mi E Coyotes (UAZ 37925); 4 mi SW Coyotes (Chrapliwy and Fugler, 1955; Smith and Chrapliwy, 1958; Duellman and Berg, 1962; Webb, 1984; KU 33855); 13 mi N Coyotes (UAZ 37923-24); 8 mi N Est. Coyotes (CAS 169749-50, 169753-54); near Est. Coyotes, 5 mi E El Salto (CAS 169765); vicinity Palo Gordo [23°27'N, 105°18'W] (UAZ 37999); Rancho Santa Barbara (KU 182638-47); 19.6 mi SE Mezquital (UAZ 45506, 45549); 10 mi W Metates (UTEP 6158-62); Rio Chico (UTEP 6165-68); 5 km E Canelas (UTEP 4105); Las Adjuntas (UTEP 6175); 3 mi E Las Adjuntas (KU 44853); 1 1/2 mi W San Luis (UTEP 6208-09); 4 km NNE La Flor [along unpaved road in 1982, meadowy area locally known as Bajio de las Ejes] (UTEP 9373, sent to Fauna Silvestre, Mexico City); 10.2 mi E Navios (RWA 5233); 1 mi ESE Cajones (Webb and Baker, 1962, MSUM 3140); 1 km NE Hacienda San Juan de Michis (MSUM 10412); Rancho Las Margaritas [= El Capulín] (Drake, 1958, MSUM); 18-20 mi W Santiago Papisquero (UCM 20949-53); ca. 15 air mi SSW Tepehuanes [25°07'55"N, 105°46'55"W] (MSUM 8940, 8942); ca. 18 air mi SW Tepehuanes

[25°06'55"N, 105°51'05"W] (MSUM 9332-34, 9340). **Sinaloa**: Sierra Surutato, 1.1 road mi SE La Cienega (McDiarmid et al., 1976, CAS 155908-09).

Additional records. **Chihuahua**: Mojárachic (FMNH 105405) and Lemos-Espinal et al., 2004b:167, UBIPRO 11840-41). Lemos-Espinal et al. (2004a:4-5) recorded UBIPRO specimens as *S. p. macrolepis* (specific localities with coordinates of latitude and longitude) from the vicinity of Mojárachic and Maguarichic (and three other sites, Quirare, Humira, and Capilla de los Remedios [last-mentioned arbitrarily listed herein as intergrade, Additional records]). **Durango**: El Salto (Dunn, 1936; Tanner, 1970); 27 mi E El Salto (Smith and Chrapliwy, 1958; Smith et al., 1964; UIMNH 41629); 1/4 mi E El Mil Diez (Rossman and Blaney, 1968); Buenos Aires (Webb, 1984, AMNH); Coyotes (Smith, "1936"[1938]:614; Smith and Chrapliwy, 1958; Marx, 1976; Webb, 1984:238; FMNH 1510 [n = 10]); 2 mi SE Coyotes, 1 mi S Hwy 40 (CM 64851-53); 66 mi W Durango [ca. 2 mi E Las Adjuntas] (FMNH 216157); 3 mi NW Coyotes (LACM 136880); La Ciudad (Boulenger, 1885:220, 1897:480 [table]; Günther, 1890[1885-1902]:65; Smith, "1936"[1938]; Webb, 1984:238; Natural History Museum, London); 142 km W Cd. Durango [Hwy 40, vicinitiy La Ciudad] (Carpenter, 1978:24); Michilía Biosphere Reserve (Ortega et al., 1982), and within 51/2 km radius La Peña (Alvarez and Polaco, 1983:87); 22 mi WSW Durango (CAS 87348); 3 mi E El Salto (CAS 91821, 91852); 32.1, 36.3, 37, 37.9, 39.3 and 57.7 road mi E (Hwy 40) Durango-Sinaloa state line (CAS 114884, 114892-93, 114895-97, 114900); 6.9 and 10.3 mi W (Hwy 40) Durango (CAS 114925, 114937-40); 15 mi W El Salto [Km 1101, Hwy 40] (CAS 120846); 6, 9, 19, 30 and 34 mi [Hwy 40] SW Durango, 2, 4, 7-8, 20, 22, and 24-25 mi [Hwy 40] E or NE El Salto, and 13-14 and 30 mi [Hwy 40] SW El Salto (Auth et al., 2000:80, SMBU); along road from Durango to La Flor, 65 to 70 km SW Durango (CAS 169781-82); Río Chico, Hwy 40 (CAS 169709).

Sceloporus poinsettii amydrus. **Mexico**: **Durango**: 1 mi NE Francisco I. Madero, Hwy 40 [24°24'20"N, 104°18'W] (MSB 39948-52); 12.9 mi NNE Durango, Hwy 40 [24°09'30"N, 104°34'30"W] (RWA 1472); 11 mi NE Guadalupe Victoria, Hwy 40 [24°31'30"N, 103°59'30"W] (RWA 4037-38, 4239, 5010, 5285, [1]); 26 mi SW Yerbaníz, Hwy 40 [24°27'20"N, 104°05'40"W] (MSUM 364); 3.2 road km SW Luis Moya, Hwy 40 [24°32'N, 103°58'55"W] (RWA 6450); 6 mi SW La Pila [24°04'N, 104°21'W] (MSUM 363, 365, 369-73, 386-88). **Zacatecas**: El Calabazal (SDSNH 52733); 3 mi E El Calabazal [23°45'N, 103°47'10"W] (UTEP 6184); Durango-Zacatecas line on Hwy 45 [23°45'45"N, 103°51'20"W] (UCM 28723-27); 5 km NE Chalchihuites [23°30'40"N, 103°51'25"W] (UTEP 6218); 3.6 mi SW Sombrerete [23°40'50"N, 103°40'15"W] (UIMNH 43298); 4 mi W Sombrerete, Hwy 45 [23°40'52"N, 103°40'20"W] (UCM 24288); 11 mi ESE Sombrerete [23°45'N, 103°47'10"W] (TNHC 30477); 12.9 mi NW Sombrerete, Hwy 45 [23°45'N, 103°47'10"W] (RWA 5230); 19 mi WNW Sombrerete (TNHC 30478); 231/2 mi S [E, Hwy 45] Sombrerete [23°35'45"N, 103°18'W] (Smith and Chrapliwy, 1958; Tanner, 1970, 1987; BYU 13855-58, 13860; CAS 93847 [= BYU 13859]); 3.7 road mi S González Ortega [23°54'30"N, 103°27'25"W] (UTEP 6189-90); 5.1 road mi S González Ortega [23°53'30"N, 103°27'] (UTEP 6215); 11 road mi S González Ortega [23°49'15"N, 103°30'35"W] (UTEP 6213-14); 2 mi W El Sauz (AMNH 118334); 91/2 mi ESE El Sauz, Hwy 45 [23°28'30"N, 103°05'30"W] (RWA 5228, [7]); 4.8 mi NW El Sauz, Hwy 45 [23°34'25"N, 103°16'20"W] (RWA [1]); 2 mi W Sain Alto, Hwy 45 [23°35'10"N, 103°16'50"W] (Chrapliwy, 1956; Smith and Chrapliwy, 1958; Duellman and Berg, 1962; KU 38097-98); 11 mi N Tropic of Cancer, Hwy 45 [23°33'50"N, 103°15'55"W] (UCM 12935); 20 mi NW Fresnillo at Tropic of Cancer, Hwy 45 [23°30'N, 103°07'30"W] (UTEP 6179); 23 mi NW Fresnillo, Hwy 45 [23°26'45"N, 103°04'20"W] (AMNH 107035, UTEP 6045); 27 mi NW Fresnillo [23°29'15"N, 103°06'40"W] (UIMNH 6591-93); 74 mi NW Fresnillo [23°42'35"N, 103°44'15"W] (UIMNH 6583-90); 32 km W Fresnillo, Hwy 45 (MCZ 136431-34); El Arenal, Hwy 45 (MCZ 136435-38); 35 km WNW Fresnillo, Hwy 45 (MCZ 136440-43); 140 mi S Torreón, Coahuila [site estimated to be along Hwy 49 near Las Nieves turnoff] (Tanner, 1987, BYU 36241); Presa Cazadero, Río Aguanaval, 9-10 mi upstream from Río Grande (AMNH 96605-06).

Additional record: **Zacatecas**: 3.8 mi SE Arenal (Olson, 1998:80, legend Fig. 2, REOlson 11469).

Sceloporus poinsettii axtelli. **New Mexico**: **Chaves County**: 26 mi E Elk, Río Peñasco, St. Hwy 82 [32°51'55"N, 104°58'10"W] (LACM 4730-31 [not examined] and MSB 13702-03); 36 mi W Artesia, Eddy County [about same site as above] (KU 73092); ca. 5 mi W (St. Hwy 82) jct with Hwy 13 [ca. 37 air mi W Artesia, Eddy County] (MSB 56291-92, 56867). **Eddy County**: Guadalupe Mountains, Sitting Bull Falls [32°14'35"N, 104°41'45"W] (MSB 41758), and 2.9 road mi NE (Hwy 276) Sitting Bull Falls (UTEP 2801); [Guadalupe Mts] 1/2 mi up Rattlesnake Canyon [32°09'15"N, 104°30'05"W] (Mosauer, 1932; Smith, "1936"[1938]:613; KU 14996); Dark Canyon (T25S, R22E, NE1/4 Sec. 17) [32°08'N, 104°43'10"W] (MSB 23615); Dark Canyon, 16 mi S-24 mi W [air] Carlsbad [T24S, R22E, Sec. 25] (MSB 48540-41), and 17 mi S-22 mi W [air] Carlsbad (MSB 4223-27, 4262); Dark Canyon, ca. 10 air km N White's City (T23S, R25E, NW1/4 Sec. 35) [32°16'N, 104°22'20"W] (MSB 23614); ca. 20.8 air km N(NE) White's City (T22S, R25E, SE1/4 Sec. 29) [32°21'35"N, 104°25'W] (MSB 38503, UTEP 1026); ca. 23 air km WSW Carlsbad (T22S, R24E, SW1/4 Sec. 23) [32°22'30"N, 104°28'10"W] (UTEP 1025); Walnut Canyon, 4 mi W White's City [32°11'10"N, 104°25'30"W] (NMSU 2505); Bat Cave Canyon [32°10'34"N, 104°22'38"W] near White's City (NMSU 2508); 11 mi S-28 mi W [air] Carlsbad (T24S, R22E, NW1/4 Sec. 3) [about same as Sitting Bull Falls] (GNHC 14074). **Lincoln County**: Sacramento Mountains, 1 mi E Capitan, US Hwy 380 [33°32'35"N, 105°33'15"W] (MSB 20508); 1 mi NW Lincoln, US Hwy 380 [33°30'N, 105°24'10"W] (MSB 20502-03); 1 mi SE Lincoln (MSB 20506); 4 mi SE Lincoln, US Hwy 380 [33°27'10"N, 105°20'W] (MBS 20507); Alamo Canyon, 10 mi SW (St. Hwy 395) jct with US Hwy 380 [33°20'35"N, 105°21'10"W] (MSB 20504-05); 1 mi N jct with US Hwy 380 on Salazar Canyon Road [33°32'15"N, 105°25'50"W] (MSB 20498-501); N Three Rivers (T10S, R10E, NW1/4 Sec. 27) [Lincoln Canyon, 33°24'55"N, 105°53'35"W] (NMSU 6301); Sacramento Mountains, 3 mi ESE Riverside [33°19N, 105°01'W] (MSB 22297); 1 mi SW Picacho [33°20'50"N, 105°10'05"W] (MSB 20510); 1 mi SE Picacho (MSB 20509); 2 mi SE Picacho [33°20'10"N, 105°06'55"W] (MSB 22434-35). **Otero County**: ca. 24 mi NE Orogrande (T20S, R12E, Sec. 17) [32°33'50"N, 105°50'15"W] (UTEP 4397-98); Sacramento Mountains, south rim Dog Canyon [ca. 32°45'05"N, 105°54'40"W] (MSB 36451); W side Sacramento Mountains, Rinconada Canyon (T13S, R10E, SW1/4 Sec. 9) [33°11'50"N, 105°59'10"W] (NMSU 6302); Guadalupe Mountains, Little Dog Canyon (T22S, R19E, E1/2 Sec. 7) [32°24'25"N, 105°02'05"W] (UTEP 13757-58); N Hueco Mountains (T26S, R10E, SE1/4 Sec. 16) [32°02'30"N, 105°55'30"W] (MSB 6300); Lewis Canyon, Cornucopia Hills (T24S, R17E, SW1/4 Sec. 16) [32°11'05"N, 105°12'55"W] (MSB 6298); Boardwell Canyon, 1/2 mi E jct with Lewis Canyon Road (T24S, R17E, Sec. 35) [32°10'25"N, 105°10'35"W] (UTEP 12309); (T21S, R14E, SW1/4 Sec. 4) [32°30'10"N, 105°31'30"W] (NMSU 6151); Cornudas Mountains, Alamo Mountain (T26S, R13E) (MSB 6848-50), (T26S, R13E, SE1/4 Sec. 20) (MSB 6299), N side Alamo Mountain (T26S, R13E, Sec. 17) [32°02'20"N, 105°37'50"W] (UTEP 11510); W side Flat Top Mountain (T26S, R13E, W1/2 Sec. 14) [32°02'30"N, 105°35'W] (UTEP 11521-22); Wind Mountain (T26S, R14E, SE1/4 Sec. 16) [32°02'10"N, 105°30'55"W] (MSB 6212); SW side Wind Mountain, 0.6 road mi SE Wind Mountain Well (T26S, R14E, NE1/4 Sec.29) (UTEP 11523). **Texas**: **Bexar County**: Helotes (MSB 8689-90, 9084); jct Farm Roads 1604 and 2696 [29°36'30"N, 98°30'30"W] (RWA 5012); along Farm Road 2696, 1.2 road mi N jct with Farm Road 1604 [29°37'30"N, 98°30'55"W] (RWA 4341, 4510); Voight Ranch, 8-12 km ENE Shavano Park (UTEP 8877-79). **Brewster County**: Alpine (UTEP 14573); Alpine, Hancock Hill (RWA 2495); 6.7 mi S (Hwy 118) Alpine (UAZ 15698); 16 mi S Alpine [30°09'40"N, 103°03'50"W] (UTEP 14575); 211/2 road mi S (Hwy 118) Alpine (UTEP 10612-15); 12 road mi S Marathon [30°02'30"N, 103°16'40"W] (UTEP 14576-77, RWA 5060); Big Bend National Park, S end Paint Gap Hills (MBS 21271), 1/2 mi N Dagger Flat Loop (MSB 21267), Chisos Mountains (UTEP 14574), Pine Canyon (BYU 40376), base Panther Peak (MSB 6327), K-Bar Ranch, 2 mi SE Panther Junction (MSB 21264-65, 21274-76), 1/2 mi S Basin Junction (MSB 21268-69, 21272), near research station (MSB 19491, 19493, 19601), NW base Casa Grande Peak (MSB 6328), near Moss Well, Lower Green Gulch (MSB 21266-67), Upper Green Gulch (MSB 21273, 21277), 1/4 mi N Glenn Spring (MSB 21270), W side Black Hills, about 2-4 km N Dove Mt. Road, and 15.0 km E jct Dove Mt Road and US Hwy 385 (UTA 17701). **Crane County**: 6.7 mi S (St. Hwy 51) Crane (RWA 4377). **Crockett County**: rocky road cut

along US Hwy 190, 12.3 mi E Pecos River (author sight record only); ca. 21/2 air km NE Fort Lancaster (UTEP 14167). **Culberson County**: Guadalupe Mountains National Park, McKittrick Canyon (UTEP 6698); Guadalupe Mountains, Frijole (Mosauer, 1932:2, KU 18425); Delaware Mts, ca. 6-7 air mi SE jct US Hwy 62-180 and St. Hwy 54 [31°42'N, 104°47'W] (UTEP 15884); Rustler Hills, along Farm Road 2185, 9.0 road mi S jct with Ranch Road 652 (UTEP 12310-11); N end Apache Mountains, along Farm Road 2185, 21.3 road mi NW jct with Farm Road 2809 [38°18'48"N, 104°32'07"W] (UTEP 13735). **El Paso County**: Hueco Mountains, within two-mile radius Hueco Tanks State Park (UTEP 170-71, 604-06, 611-15, 623, 641-49, 800, 1041-42, 1046-47, 1067, 1246, 1648, 1832-42, 2318, 2586-87, 2590, 2620-22, 2949-54, 3364, 4131-32, 6170, 10678, 10742); 6.3 mi W Hueco Tanks [31°53'50"N, 106°09'W] (UTEP 2796-97); 1.2 air mi S Helm's West Well [31°45'05"N, 106°01'45"W] (UTEP 2854-55); 1 mi S US Hwy 62-180 on Gasline Road [this intersection 0.8 mi W jct US 62-180 and Hueco Tanks road, St. Rd 2775] (UTEP 2650); 6.4-6.6 mi S and 1/2 mi E jct US Hwy 62-180 and Gasline Road (UTEP 197-98, 1068); ca. 2 mi N and 1/2 mi E jct Gasline Road and Fabens cutoff road (UTEP 10033); 4 mi W Hueco Pumping Station (in Hudspeth County) near jct Gasline Road (UTEP 4133, 5305). **Hudspeth County**: N slope Sierra Blanca Mt. (UTA 400); Quitman Mts, 8.7 mi W (via Interstate-10) Sierra Blanca (UAZ 40656); Cornudas Mountains, NW side San Antonio Mountain, just across New Mexico state line [32°00'02"N, 105°33'36"W] (UTEP 11524); Sierra Tinaja Pinta Mts, ca. 5.1 air mi NNE Cornudas [31°51'30"N, 105°28'W] (UTEP 16061); Eagle Mountains, Wind Canyon [30°54'30"N, 105°04'W] (UTEP 8171-72), Spar Valley mining area [30°56'15"N, 105°03'W] (UTEP 1873), and Siphon Canyon [30°55'30"N, 105°04'W] (UTEP 1874); Indio Mountains, vicinity Indio Ranch Research Station [headquarters ca. 30°45'30"N, 105°00'18"W] (UTEP 11385, 11482, 12007, 13693-94, 13889-90, 14027, 14079); Ojo Caliente, 30° on Rio Grande [rancho, 30°49'30"N, 105°19'W] (Yarrow, "1882"[1883]:58, Cope, 1900:353, Smith, "1936"[1938], USNM 2958 [n = 3, two recataloged as USNM 328738-39]). **Irion County**: 7 mi SW Mertzon (ASNHC 10261, 10265), 11 mi W-NW Mertzon (ASNHC 2765, 10697, 10699), 13 mi W-NW Mertzon (ASNHC 544-46, 1018, 2778, 2782-84, 2813-25, 2872-73, 3680-83, 3818, 3820, 3824-25, 3832, 4016, 4039-46, 4711-16, 4727-30); 15 mi NW Mertzon (ASNHC 10264). **Jeff Davis County**: Davis Mountains, 0.3 mi S-0.7 mi W McDonald Observatory [30°40'N, 104°02'W] (UTEP 14578); W edge Fort Davis (UTA 17245-55, neonates); near Fort Davis, Hwy 118 (UTA 8692); 1/2 mi N (Hwy 17) Fort Davis (UTEP 2812); 2 mi NW (Hwy 118) Fort Davis (UTEP 6173, 6177-78); Davis Mountains State Park (NMSU 3184); ca. 30 mi W (St. Hwy 166) Fort Davis (ASNHC 10263, 10696). **Llano County**: 7 mi S-6.1 mi W [air] Oxford [30°30'15"N, 98°48'05"W] (RWA 4437-38); 2 mi W Llano (UTA 617); Houston Ranch, 12.8 km N Llano (UTA 15019-25); 19 mi SW Llano (TCWC 58470). **Mason County**: near Pontotoc (UTA 1703); 2 mi E Katemcy (ASNHC 10453); 1 mi S Katemcy (ASNHC 10757); 6 mi S-3.8 mi W Mason, Llano River (ASNHC 10206); 9 mi SW (Ranch Road 1871) Mason (ASNHC 81, 84, 86); 15 mi S (Ranch Road 2389) Mason (ASNHC 82, 85); Hilda, "10 mi E Mason" [Ranch Road 783, ca. 14 air mi SE Mason] (ASNHC 83); 18.3 mi E (St. Hwy 29) Mason [close to Llano County line] (UAZ 2875). **Medina County**: 4 air km SSE Mico on Lake Medina (UTEP 9461). **Pecos County**: 20 mi SW McCamey, Upton County (ASNHC 10493); 6.7 mi N Fort Stockton (UTEP 11509); ca. 6 mi W-0.8 mi N Fort Stockton [30°54'30"N, 103°00'37"W] (UTEP 16067); along St. Hwy 290, 2 mi E jct with US Hwy 67 (UAZ 2874). **Presidio County**: 13.4 mi N-15.6 mi W [air] Terlingua Post Office, Brewster County [29°30'15"N, 103°49'05"W] (UTEP 14579, RWA 5057); 7.8 mi S-1.8 mi E [air] Candelaria [30°01'15"N, 104°29'20"W] (RWA 5142). **Reagan County**: Ted Harris Ranch, 12 mi S Best (ASNHC 4803). **Reeves County**: 1.8 mi S Balmorhea (UTEP 11525). **San Saba County**: Gorman Falls Fishing Camp, 6.8 mi SE Bend (ASNHC 5196). **Upton County**: King Mt., 4.6 mi NW (US Hwy 385) and 3.2 mi E McCamey (UTEP 14235). **Val Verde County**: N side Amistad Reservoir, near US Hwy 90 (UTA 16297, 18369-70); 10.6 mi N and 1.3 mi E jct US Hwy 90 and US 277-371 [29°35'N, 100°53'W] (UTEP 14572); 0.2 mi N Pecos River along US Hwy 90 (UAZ 35609); 5 mi N Pecos River along US Hwy 90 at railroad crossing (UAZ 36340); Río San Pedro [= Devils River] (Webb, 1988, USNM 2948 [n = 2, both recataloged as USNM 292581], 131668; this indefinite locality for many USNM specimens here map-plotted as restricted [30°03'40"N, 101°07'22"W] by Axtell, 2000). **Mexico**: **Chihuahua**: Sierra del Presidio, 51/2 mi NNE Samalayuca [31°18'N, 106°24'W] (UTEP 6636-38); Rancho Cerros Colorado [ca. 31°11'N, 106°22'W], 22 air km SE Samalayuca (UBIPRO 1848) and Sierra del Presidio, 10 km E Cerros Colorado (UBIPRO 2067-70) (Lemos-Espinal et al., 1997:198, 199; other specimens at UCM); Rancho El Setenta, 17 km S Samalayuca on Hwy 45 (UBIPRO 2331, 2426, 2440-42); Sierra Rica, 3.4 mi S-23.7 mi E [air] La Mula (= Potrero del Llano) [29°09'30"N, 104°03'W] (RWA 2556); 24.3 road mi S La Mula [28°53'10"N, 104°28'13"W] (UTEP 9219-20); 12.7 km S-34 km E [air] Chilicote [28°53'N, 104°29'15"W] (RWA 6426, UTEP 14589); 1 mi S San Carlos [= Benavides, ca. 29°06'30"N, 103°54'30"W] (SRSU 1547); 6 km SE Manuel Benavides at 29°05'27.7"N, 103°51'16.3"W (Lemos-Espinal et al., 2000:185, UBIPRO 4378); 1 mi N El Porvenir Salaices (SRSU 2829); 66 mi S Ojinaga (SRSU 2824-25); 1 mi S [Rancho los] Hechicero[s] [28°37'N, 103°39'W] (Chrapliwy and Fugler, 1955, KU 33811). **Coahuila**: 10 road km S road jct in San Miguel [28°32'53"N, 102°56'30"W] (UTEP 14611); 3 mi S-8 mi E [Rancho los] Hechicero[s], Chihuahua (Chrapliwy and Fugler, 1955; Smith and Chrapliwy, 1958; KU 33856); east slopes of Sierra Jardin [three sites encompassing 29°06-10'N, 102°33-38'W] (UTEP 14644-70); Sierra del Carmen (FMNH 25304-06); Sierra del Carmen, Carboneras Canyon (Gloyd and Smith, 1942:232, USNM 103693-95), El Jardin [Rancho, 29°07'30"N, 102°36'W] (FMNH 42386-88), and Tanque de Santo Domingo [Rancho, 28°56'40"N, 102°24'W] (Schmidt and Owens, 1944:104, FMNH 47103-05); Rancho Buena Vista [28°26'30"N, 102°28'W] (Cañon del Hillcoat, FMNH 47106), La Serrento (FMNH 47111), and La Palma [Rancho, 29°20'N, 102°36'W] (Mesa de Hillcoat, FMNH 47107-10, Schmidt and Owen, 1944:104); Juarez, Rancho de los Borregos (Schmidt and Owens, 1944, FMNH 47117); Sierra de la Encantada, 81/2 air km NE Rancho La Encantada [28°38'55"N, 102°20'W] (RWA [1]); 4 mi SSE Rancho La Encantada [28°32'N, 102°22'10"W] (RWA 5971); 41/2-5 mi S Rancho La Encantada (UTEP 14636, 14638); Rancho Las Margaritas [28°42'N, 101°47'W] (Smith and Chrapliwy, 1958, KU 38305-06); 3 mi W Múzquiz (UTEP 14613); 2.3 mi SW Múzquis [27°50'30"N, 101°32'57"W] (RWA [3]); 5 mi SW Múzquiz [27°48'N, 101°31'W] (RWA 1421); ca. 20 air mi ESE Zaragoza [28°23'55"N, 101°14'52"W] (RWA [1]; ca. 18 air mi ESE Zaragoza (3.7 mi from Rancho Las Cuevas) [28°23'26"N, 101°12'W] (RWA [1]); 17.2 mi SSW Villa Unión [28°03'N, 100°48'W] (TCWC 38947, 38951); 10 mi S Sabinas (FMNH 208105); 15 mi S Sabinas, Hwy 57 (Schmidt and Owens, 1944, FMNH 47118-22).

Additional records. An updated account of acceptable records of occurrence in southeastern New Mexico (*S. p. axtelli*) is mapped in Degenhardt et al. (1996). A detailed discussion of the distribution in Texas with a documented listing of localities (and map) is in Axtell (1987). **New Mexico**: **Chaves County**: 18 mi WNW Hope, Eddy County [32°52'25"N, 105°01'30"W] (AMNH 84640). **Eddy County**: Guadalupe Mts., 30 mi SW Carlsbad (CM 18303); 12 mi NW Carlsbad (CM 64850). **Lincoln County**: 19 3/4 mi E-6 mi N Capitan [T8S, R17E, Sec. 11] (Eastern New Mexico Univ. 4235, C.W. Painter, in litt.); 4.2 mi W Glencoe (TNHC 33462). **Otero County**: 2 mi N Cloudcroft (TNHC 11840). **Coahuila**: Sierra del Carmen, Juarez Canyon (Gloyd and Smith, 1942:232, FMNH 10497); Sierra del Carmen, Palau, and Hacienda La Encantada (Schmidt and Owens, 1944:104).

Sceloporus poinsettii polylepis. **México**: **Nuevo León**: Microondas La Joya access road (Hwy 57 turnoff 1.8 road mi N Nuevo León state line) [23°49'40"N, 100°31'05"W] (RWA 5731-33, [1]; UTEP 6085, 14568-69); 6.3 road mi NE Los Medina [poblado ca. 24°01'N, 101°23'W] (Hwy 57 turnoff 13.9 road mi N Microondas La Joya turnoff) (UTEP 6224); 3 1/2 road mi NNW Santa Rita [ca. 24°12'30"N, 100°29'W] (RWA 6172, UTEP 4327); 1.1 mi E Hwy 57 turnoff to San Jose de las Raices [24°33'57"N, 100°16'25"W] (RWA 6161, [1]). **San Luis Potosí**: Huertecillas [ca. 24°04'30"N, 101°08'W], 5.3 road mi (Hwy 62) W Ignacio Zaragoza (RWA [1], UTEP 3729-30); San Antonio on Hwy 62 (10.6 mi E jct Hwys 57-62 in Matehuala, or 1.3 road mi W Nuevo León state line) [23°41'30"N, 100°23'30"W] (RWA 6194, UTEP 3632-33, 3702). **Zacatecas**: Sierra de las Iglesias, 31/2 road mi W La Presa de Junco (ca. 151/2 air mi NW San Tiburcio) [24°17'45"N, 101°41'45"W] (UTEP 3614); 15 road mi SW (Hwy 54) turnoff (Hwy jct) to San Tiburcio (UTEP 3615, 8911-19); 18 km SW (Hwy 54) San Tiburcio (UTEP 6751-52); 81/2 road mi E (Hwy 62 to Matehuala) San Tiburcio (RWA [3], UTEP 3618-23).

Morphological Intermediate Variants. This first paragraph cites voucher specimens from Chihuahua and Sonora from which data were derived to indicate north-south variation in the Sierra Madre Occidental (see text): **Mexico**: **Chihuahua**: Moctezuma Mts., [near] Colonia Dublán (Smith, 1939; Bogert and Oliver, 1945:412; Tanner, 1987; BYU 401, 1323, 1324-25, 15386-87); El Norte, 3 mi N Chuhuichupa (UAZ 35183); 4 mi N Chuhuichupa (Tanner, 1987, BYU 15424); La Mesa de Dolores [ca. 70 km SW Madera on Sonora border, Van Devender and Lowe, 1977:47] (UAZ 35184-95, 35343-44); 25 road mi from Colonia Juarez toward Mesa Tres Rios (Tanner, 1987, BYU 15436-39); Cuesta El Toro, 5-6 mi S Gomez Farias (Tanner, 1987, BYU 15692, 15793); Río Chico [stream halfway between Chuhuichupa and Babícora] (Tanner, 1987, BYU 15753); Yepómera (UAZ 34212, 34219-28; UTEP 2049-50, 2255-56); Arroyo El Canon, 2 mi NW Yepómera (UAZ 34542); Rancho Casita, 3 km E Yepómera (UAZ 34211); Rancho El Cerrito, Arroyo los Punos, 6 mi E Yepómera (UAZ 34213-18, 34503); 9 mi NW (Hwy 16) Yepómera (UAZ 34540); Los Leones, 111/2 mi N (Hwy 16) Yepómera (UAZ 34504-05) [foregoing Yepómera localities in Van Devender and Lowe, 1977]; 4 mi E Temosachic (CM 59717, n = 6); [Rancho] San Pedro [28°23'30"N, 107°26'W] (map, Fig. 1 in Tanner, 1987, BYU 14523, 15771); 1 mi NE San Pedro on Río Papagochic (Tanner, 1987, BYU 15685-90, 17053-55); 18 mi SW San Pedro (Tanner, 1987, BYU 15475); 20-27 mi NE San Juanito [road to La Junta] (Tanner, 1987, BYU 41081-84); 251/2 mi S Creel [on La Bufa road] (Tanner, 1987, BYU 17138-42); 3.4 mi W-1.4 road mi N Yepachic (UAZ 46265). **Sonora**: 40-45 mi E Bacerac [seemingly close to Chihuahua state line by windy dirt road] (MSB 31233); La [Colonia] Mesa Tres Rios [ca. 29°50'20"N, 108°43'W] (UAZ 35182); 3.1 road mi below Mesa Tres Rios on road to Nacori Chico (UAZ 45618); about 4 mi E Nutria Ridge [approx. 20 mi W Sonora-Chihuahua border where Río Bavispe flows into Sonora] (Tanner, 1960; same as at Nutria Creek, small tributary of Río Bavispe and/or 4 mi E Nutria, Tanner, 1987:397; BYU 13491); La Cuesta, ca. 10.2 mi E Santa Ana [Santa Ana 28°23'N, 109°09'W] on road to Yécora (UAZ 28215-16); 13.3 mi (by old road to Yecora) SE Santa Ana (UAZ 39419); 3.0 mi (by road to Santa Rosa [28°26'N, 109°11'W]) "NE"[NW] Yécora (UAZ 39420); 3.4 mi NW Yécora along road to Santa Rosa (UAZ 45077-78); 3.8 mi (by road to Santa Rosa) "NE"[NW] Yécora (UAZ 39421-22, 40043); 4.7 mi S (and 0.3 mi [no road] W) Yécora on road S to Rancho La Joya (UAZ 46232); 5.9 mi (by road to Santa Rosa) NW Yécora (UAZ 38822, 39423); 6.4 mi NW Yécora along road to Santa Rosa (UAZ 44918); 6.8 mi (by road to Santa Rosa) "NE"[NW] Yécora (UAZ 39430); 12.1 road mi E Yécora along road to Trigo (UAZ 46231); 7.3 mi W Maicova (UAZ 39971-72).

Chihuahua: Casas Grandes (Smith, "1936"[1938]; FMNH 1655); 111/2 mi SE Nuevo Casas Grandes (Tanner, 1987, BYU 13853); 12 mi SE (Hwy 10) Nuevo Casas Grandes (UTEP 14585); W Janos (Tanner, 1987, BYU 30645); near [Ejido] Progreso, Río Santa Maria (Smith and Chrapliwy, 1958, USNM 104713-14); 14 mi W Ricardo Flores Magón (Tanner, 1987, BYU 15334); 7 mi E (Hwy 10) Ricardo Flores Magón (UTEP 14584); 3.6 km N-1.2 km E [air] jct Hwys 45 and 10 (= El Sueco) [29°55'20"N, 106°22'50"W] (UTEP 14586); 10 mi S Moctezuma (Smith, "1936"[1938]; Smith and Chrapliwy, 1958; UIMNH 21463; FMNH 32238, 32248-50, 116570, 116576); 7 mi E Buenaventura (Tanner, 1987, BYU 40078); 11.0 road mi S Buenaventura (UAZ 36304-05); 14 road mi SW Buenaventura (UTEP 6216); 50 mi S Gallego (Tanner, 1987, BYU 13926); 40 mi SW El Sueco (Hwy 45) on E side Sierra del Nido (UTA 4373); Sierra del Nido, Arroyo Mesteño [ca. 29°29'N, 106°49'W] (MSB 30578), 11 mi N Restaurant Parada [road NW Las Varas, 29°21'40"N, 106°36'W] (RWA 3373), and Cañon Santa Clara (UTA 17496); 71/2 road mi W Bella Vista [29°04'30"N, 106°29'30"W] (UTEP 8822-25); 6 mi N (Hwy 45) El Sauz turnoff (CM 59702); 9 mi W Hwy 45 on turnoff to El Sauz (MSUM 9675); 4 km S-1.6 km W [air] Sacramento turnoff (ca. 20 mi N Cd. Chihuahua) [28°49'N, 106°13'05"W] (UTEP 14590); 7 mi N Cd. Chihuahua (FMNH 95976); 5 km SW Cd. Chihuahua (CM 59698, 59701); 50 mi W (Tanner, 1987, BYU 13812-25) and 62 mi W (Hwy 16) Cd. Chihuahua (Tanner, 1987, BYU 13861-65); General Trias centro (MSB 33201-05); 1 km E General Trias centro (MSB 31363); 8 mi W General Trias (RWA 4580); 12.9 road km WSW General Trias [28°18'35"N, 106°28'50"W] (UTEP 14591); 1 mi E El Mirador (Hwy 16) [28°18'35"N, 106°28'50"W] (UTEP 14606); 15 mi E Cuauhtémoc (Smith and Chrapliwy, 1958, UIMNH 41626-27, 41637-38); 10.4 mi (Hwy 16) NW Cuauhtémoc (Van Devender and Lowe, 1977, UAZ 34541); 11/2 mi W La Junta (UTEP 6217); 4 road mi SW (UAZ 30970) and 9.4-10.4 road mi SW Rancho Los Chales [rancho ca. 30°03'N, 108°32'W, near Sonora state line] (UAZ 30975); 0.9 km S-1.7 km E (air) [S Hwy 45 jct.] Hidalgo del Parral [26°55'10"N, 105°38'W] (RWA 6428); 4 mi SSE Parral (RWA); 16 road mi S Parral (RWA 1439); 27 mi S Parral (Tanner, 1987, BYU 15652); 15.4 mi S Matamoros (Tanner, 1987, BYU 41777-78); 10 mi W San Francisco del Oro (Tanner, 1987, BYU 15679-83, 15710); near Belleza [specimen obtained 23 September 1898, see Goldman, 1951:118] (Smith, "1936"[1938]; Smith and Chrapliwy, 1958; Tanner, 1987; Cochran, 1961; USNM 47417); La Union, "N" [= WSW, 26°48'N, 107°09'30"] Guachochic [= Guachochi] (Stebbins, 1954:236); Sierra Madre, near Guachochic [26°49'N, 107°04'W] (Smith, "1936"[1938]; Goldman, 1951:127; Smith and Chrapliwy, 1958; Cochran, 1961; Tanner, 1987:398 [cited USNM numbers incorrect]; USNM 47419, 47421 [USNM 47420 exchanged to MCZ, not examined]); Km 66 (66 km S Creel) on Hwy between Creel and Guachochi (Lemos-Espinal et al., 2000:185, UBIPRO 3990); Mesa de Agostadero, [Rancho] Cerro Blanco, Km 102 on Guachochi-Belleza Hwy [26°54'38.7"N, 106°47'14.1"W] (Lemos-Espinal et al., 2000:185, UBIPRO 4023-24; Lemos-Espinal et al., 2004b:167, UBIPRO 11456; Lemos-Espinal et al., 2004c:61, color photo 62); Samachique (Smith, "1936"[1938]; Smith and Chrapliwy, 1958; FMNH 11841-47, 15724 [n = 11]); 2 mi W Samachique (KU 47291); 2 mi W Miñaca [28°27'N, 107°25'W] (KU 51824-29, 51834-36); 4 mi SW San Francisco de Borja [27°55'N, 106°41'W] (KU 56214); near Ojito [Durango], ca. 50 road km (via El Vergel) W Parral (UAZ 33192); 27 mi W Jimenez (UAZ 2877); 1 mi S El Tigre, Lago Boquillas [ca. 17 mi W Camargo] (UTEP 3587-92); Rancho Polvorillas [= Piedras Encinadas, 28°47'36.2"N, 104°13'30.8"W] (Lemos-Espinal et al., 2000:185, UBIPRO 3632-33, 3652-53); Llano El Nito, 11/2 km N Rancho Polvorillas (UBIPRO 3707); Cerros Tres Castillos [ca. 11/2-21/2 km SW of 29°54'41.8"N, 105°42'13.7"W] (Lemos-Espinal et al., 2000:185, UBIPRO 4283-89); Cerros Santa Anita [29°40'14.1"N, 105°19'13.6"W] (Lemos-Espinal et al., 2000:185, UBIPRO 4301-12); 18 mi N[NW] Escalón [along railroad track, 26°53'55"N, 104°33'15"W] (Smith, "1936"[1938], Smith and Chrapliwy, 1958; Smith et al., 1964; UIMNH 21464-66); 15 mi NW (Hwy 49) Escalón [26°52'20"N, 104°31'W] (UTEP 9231-35, RWA [1]); 20 mi NW (Hwy 49) Escalón [26°55'20"N, 104°35'13"W] (UTEP 9222, RWA [1]); 13.3 mi E[NE] Escalón [= 0.8 mi W Mercurio, 26°50'35"N, 104°09'W] (UTEP 9223-26, 14627-30); 4 mi N La Perla [28°21'40"N, 104°31'W] (UTEP 9221); 15.2 mi N La Perla, Hwy 49 [= 1.7 mi S La Morita, 28°29'08"N, 104°28'13"W] (UTEP 9228-30, 14587-88); 12 mi SE La Perla (SRSU 2826-28); 28 mi NE La Perla [Hwy 49, ca. 39 road mi S La Mula] (CM 59695); Cerro La Cañada, outside of La Perla (= El Berrendo) [28°17'59.8"N, 104°33'5.0"W] (Lemos-Espinal et al, 2000:185, UBIPRO 3581-82, 3584); Rancho San Fernando, 341/2 mi W Laguna de Jaco [ca. 27°58"N-104°37'W] (CM 59716); Rancho San Francisco [28°02'30"N, 104°26'W] (Lemos-Espinal et al., 2001:206, UBIPRO 5218-27,5268-71; UTEP 19197-99). **Coahuila**: Puerto del Jabali, Llano del Guaje [27°31'20"N, 102°53'50"W] (USNM 241518); 5.4 mi NW Ocampo (UAZ 37921); 10 mi S-4 mi W [air] Ocampo [27°10'20"N, 102°27'15"W] (RWA 4033, UTEP 14609); 341/2 km N Ocampo [27°36'44"N, 102°24'50"W] (UTEP 14614); 2 mi N Cuatro Ciénegas (CM 48326); 2.6 mi N Cuatro Ciénegas (UAZ 37922); 3 mi N Cuatro Ciénegas (CM 43036-38, 43040, 43043-44); 4.9 mi W Cuatro Ciénegas (CM 59719); 51/2 mi SW [Hwy 30] and 7.0 mi S [dirt road] Cuatro Ciénegas (ASU 5478); 6.9 mi SW Cuatro Ciénegas (CM 48301-02, 48311-12); 8.6 mi SW Cuatro Ciénegas, N side Sierra San Marcos (CM 43045); W side Sierra San Marcos, opposite Laguna Churince (UTEP 9203, 14612); 16 km S Cuatro Cienegas (KU 47038-40); 40 km SW Cuatro Ciénegas (CM 43041-42); 84.4 mi S Cuatro Ciénegas (SRSU 2830); 11 mi N Cuatro Ciénegas (UTEP 14631-33); 1.7 km N-3.3 km W [air] jct Hwy 30 and turnoff to Lamadrid [27°01'50"N, 101°49'30"W] (UTEP 14615-16); 62.6 mi N San Pedro de las Colonias (SRSU 2999); 32 mi N San Pedro de las Colonias (CM 59703-04); SW [ca. 9 mi or 15 km] Rancho El Porvenir at Cuesta del Gallo [26°48'40"N, 103°04'W] (CM 59720); 1 mi W Las Delicias (CM 59705-06); Sierra de la Candelaria [6.7 mi SE Las Delicias turnoff, Hwy 30] (RWA [1]); Puerto de las Ventanillas, about 25 mi N (Hwy 30) San Pedro de las Colonias (USNM 241519); 1/2 mi S Parras (CM 59707-08); Cerro La Cuchilla [just N jct Hwy 40 and road to San Pedro de los Colonias] (USNM 105528-32); 14.3 mi SE Viesca (CM 59715); 17.8 and 18.3 mi SW Viesca (SDSNH 49785-86); 7.8 mi NW Ahuachila (UTEP 9227); 8.3 km N-1.6 km W [air] Ahuachila [25°11'20"N, 102°38'50"W] (UTEP 14610); "Monclova" [Goldman, 1951:130] (Smith, "1936" [1938], USNM 46699); Sierra de la Gloria, Monclova (Schmidt and Owens, 1944, FMNH 47123-24); Sierra de la Gloria, 8.8 mi S-

4.2 mi E [air] Monclova [26°46'20"N, 101°21'W] (RWA [1]); 10 mi S Monclova (CAS 87126); 35.3 road mi E Monclova [road to Candela at 26°46'15"N, 100°58'20"W] (UTEP 6195); 1 mi W Estación Candela (UTA 7959); 9 km S and 3 km E [air] Castaños [26°39'10"N, 101°22'40"] (RWA 4780); La Muralla Canyon area north of San Lazaro, along Hwy 57 [encompassed by about 26°18-21'N, 101°21-22'W] (Axtell and Axtell, 1971, RWA 3832, UTEP 4238, 14621-24, 14634-35); 5 road mi S (Hwy 57) Palo Blanco [Palo Blanco is 4 road km SE San Miguel, 25°33'N, 101°01'50"W] (RWA [1]); 51/2 mi W-61/2 mi S (Hwy 57) Sauceda (RWA 3831); 21/2 km N-0.4 km E [air] Hacienda de Guadalupe [26°10'10"N, 101°17'35"W] (UTEP 14617-20); 21 mi N Saltillo (Smith and Chrapliwy, 1958 [21 mi N Hipolito, in error], USNM 105763, 105789-93); 7.6 mi N Saltillo (UCM 41492-93); 10 mi ENE Hipolito (Smith and Chrapliwy, 1958, USNM 105786-88); Rancho (San Antonio del) Jaral [25°37'N, 101°24'W] (Smith, "1936"[1938]; Smith and Chrapliwy, 1958; FMNH 1547); "Sierra Guadalupe" [Goldman, 1951:133] (Smith, "1936"[1938]; Smith and Chrapliwy, 1958; USNM 47491-92); 3 road mi S Ojo de Agua [= El Capricho, on road to General Cepeda] (RWA [1]); 1 mi NW Est. La Paz [25°18'40"N, 101°26'W] (RWA 5970, UTEP 14637); 1 mi S Los Encinos at Santo Domingo turnoff, Hwy 57 [25°37'30"N, 101°06'W] (UTEP 14607-08); 4 mi W [Ejido Santa Teresa de los] Muchachos [ca. 25°18'30"N, 101°22'N] (UTEP 14639-43); 10 mi S-5 mi W General Cepeda (Smith and Chrapliwy, 1958, KU 33974, 37546-67); 3 mi NW (Hwy 40) La Rosa (Smith and Chrapliwy, 1958, KU 28161); [near] Saltillo (Smith and Chrapliwy, 1958, USNM 112288-92); 7.8 mi N-31/2 mi E Saltillo (RWA 4812); 15 mi E Saltillo (Smith, "1936"[1938], FMNH 32378); El Chiflon, Hwy 40 [ca. 25°27'45"N, 101°19'W] (UTEP 6786); Mount Zapalinamé (near top of Diamond Pass) [Sierra Zapalinamé, peak about 13 air mi SE Saltillo, 25°22'04"N, 100°55'W] (Smith and Brown, 1941:253; Smith and Chrapliwy, 1958; USNM 105761-62); 3 mi E Bella Union [near Arteaga] (KU 39878); 9.8 mi SE Saltillo (TCWC 35293); 13 mi SSW Saltillo [ca. 25°14'N, 101°04'30"W] (UTEP 4457); 15 mi SE (Hwy 57) Saltillo (Tanner, 1987, BYU 36243-49, 36399); 3.4 km W Ejido Palmas Altas [25°08'15"N, 101°27'45"W] (RWA 3673); 1/2 mi N Sierra Hermosa [25°19'15"N, 100°53'W] (UTEP 6066); 31/2 mi SE [Ejido] Angustura (UTEP 6065); 9.3 mi SE Villa de Arteaga (KU 43293); 3.2 mi S-31/2 mi E [air] Villa de Arteaga, Hwy 57 [25°24'20"N, 100°47'50"W] (RWA 5221); Villa de Arteaga (Smith and Chrapliwy, 1958, USNM 105794-822); 1.1 km S-3.1 km W [air] San Antonio de las Alazanas [25°15'44"N, 100°36'36"W] (RWA 6314); 2 mi W-1.4 mi S San Antonio de las Alazanas on Cienega del Toro road (EAL 4179 [n = 16], 4317 [n = 7]). **Durango**: 10 mi SE Santiago Papasquiero (MSUM 2776-79); 41/2 mi S Tepehuanes (MSUM 8939); 3 mi E Las Nieves (MSUM 764-67, 769), 31/2 mi E Las Nieves (SRSU 3476), and 49 mi S Parral, Chihuahua (SRSU 3081-83, 3132) [both Las Nieves and the Parral sites at jct Hwy 45 and Río Florido]; 1.3 mi S Las Nieves (UAZ 46794); 20 mi SE Las Nieves (MSUM 9330-31); El Palmito (UTEP 3717-18); 2 mi S El Palmito (MSUM 2775); 11 mi E La Zarca (UTEP 6171); 15 mi S La Zarca (UCM 8970, 13701-02); Rancho El Cortijo [26°09'N, 105°11'W] (MSUM 756-58, 760-63); 1 mi N San Antonio (UTEP 6210); 7.3 road mi N (Hwy 45) Primo Verdad (UTEP 9394); 81/2 mi N Donata Guerra (RWA [1]); 8.4 mi W (Hwy 30) Rancho Tres Hermanos (UTEP 3719); 52 road mi N (Hwy 45) Cd. Durango (UTEP 6670); 24 mi N Durango (Smith and Chrapliwy, 1958; Smith et al., 1964; UIMNH 40474); 4 mi S Morcillo (MSUM 4303); 3 mi W Cd. Durango (UTEP 6176); 5 mi S Durango (UCM 20947); 5.4 mi SW Durango (UIMNH 43294); 9.8 mi NNW Nombre de Dios (RWA 2428, UTEP 14599); 20.4 road mi SSE Cd. Durango, Hwy 45 [23°58'N, 104°21'30"W] (RWA 5231); 13 mi N (MSUM 4305) and 15 mi N Mezquital (MSUM 4304); 16 mi S and 20 mi W Vicente Guerrero (MSUM 362, 366-67); 3 mi E Yerbaníz (UTEP 6193); 1 mi SE Doce de Diciembre (= Sombreretillo, UTEP 6191-92); Hacienda de Atotonilco, 12 mi SE Yerbaníz (Webb and Hensley, 1959; KU 40415, 40424-26, MSUM 11260, UTEP 6164, 6172, 6174, 6183); 14 mi S-111/2 mi E [air] Cuencamé [24°40'N, 103°31'W] (RWA 5223-24); Presa Francisco Zarca (UTEP 14596); 25 mi S Gomez Palacio [near Chocolate] (Tanner, 1987, BYU 40115); 10 mi W Gomez Palacio (Tanner, 1987, BYU 40064-65); 25 mi S Torreón, Coahuila [near Chocolate] (Tanner, 1987, BYU 36240); 5 km W [along railroad] Torreón, Coahuila (FMNH 218894); 11.2 mi S Chocolate (UTEP 9403); 9.8 km S-3.2 km W [air] Chocolate (RWA 6439, 6443; UTEP 14598); near Pedriceña (Smith, "1936"[1938]; Smith and Chrapliwy, 1958; Smith et al., 1964; UIMNH 21459); "close to Pedriceña" (UBIPRO 1908-1920); 4 road mi N turnoff to Pedriceña [25°08'10"N, 103°45'15"W] (RWA 4036); 6 mi NE [or N] Pedriceña (Smith, "1936"[1938]; Smith et el., 1964; UCM 50069, 50415; UIMNH 21460-61; UTEP 6180-82), and Tanner, 1987 (BYU 36236-38); 61/2 mi N Pedriceña (UTEP 6163); 12 mi N Pedriceña (UCM 50070-74); 1.7 km N-3.7 km W [air] La Campana [26°08'40"N, 103°32'W] (UTEP 14597); 26 mi N Tlahualilo (TCWC 43893); Cerro San Ignacio [26°40'N, 103°44'W], Mapimí Biosphere Reserve (Grenot and Price, 1978; Grenot et al., 1978; Maury and Barbault, 1981; UTEP 9402); Sierra de Banderas, 3 mi E Conejos (UTEP 6169); 0.5 mi NE Dinamita (UTEP 3731); 0.7 mi SW Picardias (UTEP 9242-43, 14595); 1.9 mi SW Picardias (RWA [1]); 5 mi S La Unión (UTEP 9178); 4.2 mi W La Pendencia, Zacatecas (UTEP 9185-87). Precise collection data lacking for specimens designated "Sancada" [not found] (UBIPRO 1921-22) and "Durango 2" (UBIPRO 1923-55), collected next to the road in August 1997 (Julio A. Lemos-Espinal, in litt., 14 January 2002). **Nuevo León**: 2.6 road mi SW El Castillo [25°10'35"N, 100°37'50"W] (RWA 5852, UTEP 6043-44, 14625); near Coahuila border 1.8 mi W-3.3 mi S [air] San Antonio de las Alazanas on Cienega del Toro road at Ejido 18 de Marzo [25°15'N, 100°35'30"W] (EAL 5014 = KU 203847); 15 mi W Santa Catarina (Smith and Chrapliwy, 1958, USNM 105827-28); Cañon de Huasteca near Santa Catarina (Smith and Chrapliwy, 1958, KU 192602, 192605; USNM 105829); 3.2 mi W (Hwy 34) Sabinas Hidalgo (EAL 4253); 5 mi W and 2 mi S Sabinas Hidalgo [26°29'N, 100°15'20"W] (RWA 4789); 4 mi NW Sabinas Hidalgo (FMNH 32229); 3 km W Sabinas Hidalgo (FMNH 38618); 9 road mi NE Villa de Garcia [25°51'N, 100°31'30"W] (RWA 3840, 3940); Picacho Mts, 9.8 km SW Cerralvo and 10.1, 11.9, 13.3, and 16.7 km W "on" Rancho El Milagro [rancho ca. 26°19'N, 99°39'W] (Chaney et al., 1982, EAL 4296, 4297 [n = 5], 4301, 4565, 4572); 2 mi SW Bustamante (EAL 3909, 3913 [n = 3]); 1.9 mi W (EAL 4527 [n = 3]), 3 mi W (EAL 4330), 4.4 mi W (RWA 4810-11), 5.7 mi W (EAL 4523), and 17.4 mi W Bustamante (EAL 4334 [n = 4], 4516 [n = 6]); 0.7 mi S-2.0 mi W [air] Bustamante [26°31'30"N, 100°32'10"W] (RWA 4600); 3.7 km N-1 km W [air] Cuato [SW Bustamante, 26°24'N, 100°35'55"W] (RWA [2]); 8.8 km W jct Hwy 61 and road to Bustamante [26°32'45"N, 100°32'45"W] (RWA [1]); near Cienega de Flores (Smith, 1939:225, FMNH 32230, and [near km 1036] 116575, 123818). **Sonora**: 10 mi E Huachinera (CAS 15206); 10.2 road mi below Mesa Tres Rios on road to Nacori Chico (UAZ 53500). **Zacatecas**: 4 km N San Juan de los Charcos (UTEP 4438); 10 mi ESE San Juan de los Charcos (UTEP 6185-88); 5 mi NE Cinco de Mayo (Baker et al., 1980, sight record only); 8 mi S Chalchihuites [23°23'N, 103°54'W] (CAS 95919-22); 18 mi NE Nieves (UTEP 3629); 18.9 mi NE Nieves (CM 59711-14); 27.8 mi NW Camacho [road to Mazapil] (CM 59709-10); Coapas (SDSNH 49788-90, 49793-94); 0.7 mi N Coapas (UTEP 14594); 2.3 mi N Coapas (SDSNH 49791); 31/2 km N-1/2 km W [air] Coapas [24°48'35"N, 102°10'40"W] (RWA 5809); 16 mi W Las Norias [24°59'N, 102°13'W] (UTEP 6194); 0.6 km W Tecolotes [24°37'30"N, 101°58'45"W] (UTEP 14626; SDSNH 49787, as 0.4 mi W); 0.1 mi ENE Tecolotes (UTEP 14592-93); Pico de Tiera, 15 mi NE Camacho (UTEP 6197-98); 0.3 km N-2.2 km W [air] Concepción del Oro [24°36'55"N, 101°26'20"W] (RWA 6170).

Additional records. **Chihuahua**: Colonia Garcia (Smith, "1936"[1938], Acad. Nat. Sci. Philadelphia); Arroyo del Alamos (Smith, "1936"[1938], USNM 42873); 10 mi S Casas Grandes (Smith and Chrapliwy, 1958, USNM 105342); Llano de Flores Magón [30°0'29.9"N, 107°15'11.6"W] (Lemos-Espinal et al., 2004b:167, UBIPRO 11843-44; Lemos-Espinal et al., 2002:165 [same, slightly different coordinates]); Ejido Flores Magón [29°57'34.0"N, 107°6'29.6"W] (Lemos-Espinal et al., 2001:206, UBIPRO 5728-31); 7 mi E San Buenaventura (Smith and Chrapliwy, 1985, USNM 105338-41); Yepómera (SDSNH 48999); 6 mi E Yepómera [Rancho EL Cerrito] (SDSNH 49000); 20 km NW Chihuahua, 50 km N-45 km W Chihuahua, Parque Nacional Majalca, 60 km S and 20 km W El Sueco, 5 km NE Ignacio Zaragoza, 20 km N-20 km E Cuauhtémoc, 45 km N and 30 km E Cuauhtémoc, 4 km S-10 km W Metachic, 14 km S-24 km W Metachic, and 5 km NE Tesonachic (Domínguez et al., "1974"[1977]); Presones de la Capilla de los Remedios, Lago Las Mexicanos [28°7'7.5"N, 106°56'28.9"W] (Lemos-Espinal et al., 2004a:5); Valle de los Pinos, 9 mi S Creel [27°41'43.5"N, 107°35'8.1"W] (Lemos-Espinal et al., 2001:206, UBIPRO 5843); Rancho Santa Lucía [29°32'30.3"N, 105°19'53.3"W] (UBIPRO 5535), and El Ranchito [28°01'5.9"N, 104°00'22.0"W] (UBIPRO 6232) (Lemos-Espinal, 2001:206); Creel, San Ignacio, Sierra Tarahumara (Flores-Villela, et al., 1991:131); Balneario Division del Norte [26°53'32.8"N, 104°22'17.8"W] (Lemos-Espinal et al., 2002:166, UBIPRO 8026); Sierra Encinilla, Rancho El Gatuno [= Gatunozo, 28°6'51.1"N, 104°5'52.2"W] (Lemos-Espinal et al., 2001:206, UBIPRO 5306-07,

5323, 5353; same as "26°"[= 28°]6'50.7"N, 104°5'51.4"W in Lemos-Espinal et al., 2002:166, UBIPRO 7509-23, 7540-41, 7547-57; also color photo 61 in Lemos-Espinal et al., 2004c:61). Lemos-Espinal et al. (2001:206, and 2002:165) cited additional localities of Chihuahuan UBIPRO specimens, and (2004a:5) recorded Sierra del Nido UBIPRO specimens (specific localities) as intergrades. **Coahuila**: Monclova (Garman, 1887, MCZ); 65 km S Monclova, Hwy 57 (Carpenter, 1978:24); Hacienda Los Borregos, and Sabinas (Schmidt and Owens, 1944, FMNH); 10 mi ENE Saltillo (SDSNH 40277-79); Saltillo (Smith, 1939:225, Acad. Nat. Sci. Philadelphia 20114); N side Sierra in front of Hercules mine [28°2'11.8"N, 103°38'14.0"W] (UBIPRO 5358), and El Alicante [27°56'27.2"N, 103°34'16.9"W] (Lemos-Espinal et al., 2001:206, UBIPRO 5363-64). **Durango**: "Durango, Durango" (Smith, "1936"[1938]; Smith and Chrapliwy, 1958; Cochran, 1961; USNM 46844-45); 82 mi S Hidalgo del Parral (Hwy 45), Chihuahua [ca. 12 mi N La Zarca] (CM 59696); 19 km N Pedriceña (Carpenter, 1978:24); near La Loma (Smith and Chrapliwy, 1958 [not La Goma]; Cochran, 1961; USNM 105486-92); 15 and 25-26 mi SW [Hwys 40-49] Torreón [Coahuila] (Auth et al., 2000:80, SMBU); vicinity of Pedriceña (Smith and Chrapliwy, 1958 [same USNM numbers as "betw Lerdo and La Goma"]; Cochran, 1961, as "Pedriceña"; USNM 105493-97); 14 mi N Pedriceña (Smith and Chrapliwy, 1958, as "vicinity of Pedriceña"; Cochran, 1961; USNM 105498-500); 7 mi NE Pedriceña (CM 59697); near Pasaje (Smith, "1936"[1938]); Sierra de las Banderas, opposite Conejos (CM 59718); Presa Francisco Zarca [25°9'17.4"N, 103°46'20.2"W, UBIPRO 6047] and La Campana cemetery [26°7'39.1"N, 103°41'00.0"W, UBIPRO 5060] (Lemos-Espinal et al., 2001:206; latter locality also cited in Lemos-Espinal, 2002:165, UBIPRO 7940-41). **Nuevo Leon**: Cañon de Huasteca, 11 mi W Monterrey (Smith, 1939:225, FMNH 32231-32); 12 mi W Monterrey (FMNH 105402-03); 20 mi N Monterrey (FMNH 25434); 30 mi W Monterrey (Smith, "1936"[1938], FMNH 116579); Santa Catarina (Yarrow, "1882"[1883]:58, as *S. torquatus*, USNM 4107; Cope, 1900, USNM 2966, and Smith, "1936" [1938]); 4 mi W Sabinas Hidalgo (Smith, 1939:225, EHT 8738-39), EHT 738-39). **Sonora**: vicinity Yécora (Lara-Gongora, 1986).

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The Amphibians and Reptiles of The Asbury Woods Greenway, Erie County, Pennsylvania

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Abstract

The Asbury Woods Greenway, an area of approximately 200 acres of diverse habitat, including hardwood forest, old fields, streams, and wetlands, was surveyed periodically between 1998 - 2005. Twenty-six species of amphibians and reptiles were found to occur at the site, including ten salamander, seven frog, seven snake, and two turtle species. The rarest species were the Northern Two-lined Salamander *(Eurycea bislineata)*, Northern Red Salamander *(Pseudotriton ruber ruber)*, and the Northern Ribbon Snake *(Thamnophis sauritus septentrionalis)*, each with only a single individual observed. The most abundant species were the Allegheny Dusky Salamander *(Desmognathus ochrophaeus)* (n=74), Northern Redback Salamander *(Plethodon cinereus)* (n=57), and the Green Frog *(Rana clamitans melanota)* (n=47). No threatened or endangered species were observed. Effort should be made to preserve suitable habitat on adjacent land, especially in the Walnut Creek Zone, where the greatest herpetofaunal diversity occurs.

Introduction

The Asbury Woods Greenway (AWG) is located about 4 miles southwest of Presque Isle State Park in Millcreek Township, Erie County, Pennsylvania, and consist of approximately 200 acres. The site is divided into seven land-use zones (figure 1): Nature Center (NCZ), Community Park (CPZ), Nature Preserve (NPZ), Walnut Creek (WCZ), Brown's Farm (BFZ), Weis Library Heritage Zone (WLZ), and Walnut Creek Middle School (MSZ) (SCPS, 1999). The WLZ and MSZ were not surveyed. The AWG property is managed by a partnership between Millcreek Township, the Millcreek Township School District, and Mercyhurst College. Much of the area was farm, pasture, and orchards until approximately 60 yrs. ago.

Habitats present in the Nature Center Zone include a hardwood forest of Maple *(Acer spp.)*, Beech *(Fagus grandifolia)*, Red Oak *(Quercus rubra)*, Tuliptree *(Liriodendron tulipifera)*, Black Cherry *(Prunus serotina)*, and Eastern Hemlock *(Tsuga canadensis)*. Plantations of Norway Spruce *(Picea abies)*, Scotch Pine *(Pinus sylvestris)*, White Pine *(P. strobus)*, Austrian Pine *(P. nigra)*, a grove of Chinese Chestnut *(Castanea mollissima)*, and a meadow were also present. Current plans are to remove the nonnative species in this zone, and replant the section with native species. Wetlands in the NCZ include herbaceous vernal pools, a buttonbush wetland (Fike, 1999), and to the north of the property, a semi-permanent pond. The NCZ is used for nature hikes and environmental education programs.

Asbury Community Park (CPZ) is located to the west of the NCZ and Asbury Road, and consist of a baseball field, tennis courts, and a picnic area. A stand of coniferous trees to the north may provide habitat for salamanders; while an ecotonal area of

forest and field to the west provides limited habitat for snakes. The primary land-use of this zone is for recreational purposes. The CPZ is bordered to the west by the James Wildlife Preserve Zone (NPZ).

The NPZ contains hardwood forest similar in species composition to that of the NCZ, with Oak *(Quercus spp.)*, Ash *(Fraxinus spp.)*, Red Maple *(Acer rubrum)*, Ameri-

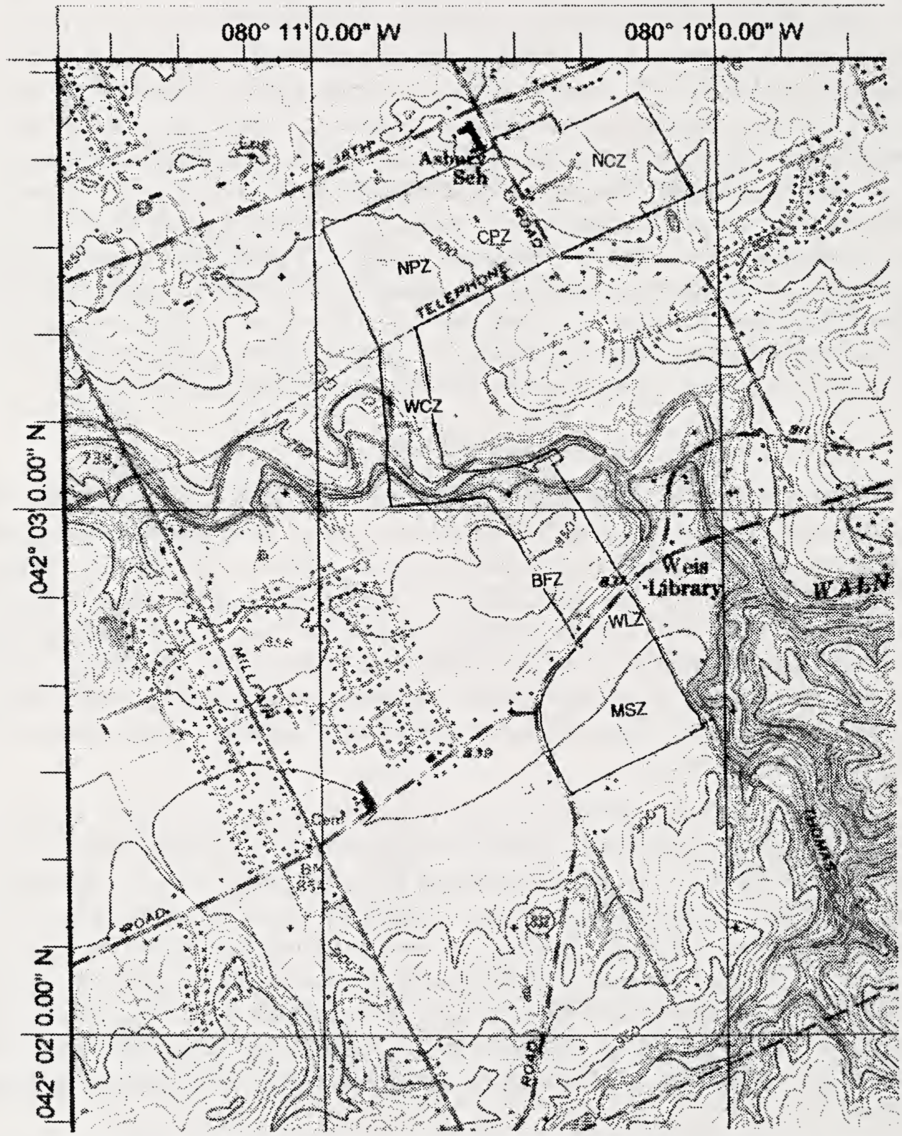

Figure 1. Land-use zones of the Asbury Woods Greenway, Erie County, Pennsylvania: Brown's Farm (BFZ), Community Park (CPZ), Nature Center (NCZ), Nature Preserve (NPZ), Walnut Creek (WCZ), , Weis Library Heritage Zone (WLZ), and Walnut Creek Middle School (MSZ). Site boundaries on map are approximate.

can Basswood *(Tilia americana)*, Yellow Birch *(Betula alleghaniensis)*, and Tuliptree *(L. tulipifera)* present. Wetland diversity in this zone include: palustrine wetland, scrub/shrub wetland, swamp, and open emergent/spring seep. Hiking trails in this area are used for recreation and educational hikes.

Located to the south of the NPZ is the Walnut Creek Zone (WCZ). Walnut Creek is a medium sized stream, and in this portion of the AWG has a narrow floodplain. Two habitats in this zone are considered imperiled within Pennsylvania: The Mesic Central Forest, dominated by Beech and Maple, and the Calcareous Seep Community (SCPS, 1999). Several vernal pools, a remnant oxbow lake, and small tributary streams (both permanent and intermittent) also occur in this zone. The southern section of the WCZ is characterized by a wooded hillside. Hiking and fishing are the most common activities in the WCZ.

Brown's Farm (BFZ) is located to the south of the WCZ and is dominated by old field/meadow habitat, with goldenrod *(Solidago spp.)*, aster *(Aster spp.)*, and grasses dominating. Trails here are used by local high school cross country track teams, birders, and nature hikes. A small tributary stream flows through part of the BFZ and drains into Walnut Creek at Buttermilk Falls.

The purpose of the 2002-2005 survey was to augment the results of the former reports (Gray, 2002a; Gray 2002b.), and to provide a more quantitative estimate of amphibian and reptile relative abundance at the site. This base line data may be useful in preparing management plans that take into consideration the herpetofaunal diversity at the site.

Materials and methods

The AWG was surveyed over eight field seasons (1998-2005), using opportunistic sampling. Logs, rocks, and other cover objects were searched for the presence of amphibians and reptiles. Frogs were also identified by their species-specific calls; whereas basking turtles were observed through binoculars. All hand-captured animals were released after identification. In addition, shed snake-skins were occasionally found and identified. Time spent searching for amphibians and reptiles per month was as follows: February (0.25 hrs), March (6.00 hrs), April (30.4 hrs), May (30.4 hrs), June (39.5 hrs.), July (10.6 hrs), August (6.00 hrs), September (7.60 hrs), and October (21.25 hrs). I have combined the data for both sampling periods, as the combined data more likely provides a better approximation of the relative abundance of each species than the two periods taken separately. Relative abundance (capture rate) for each species was calculated by dividing the number of individuals observed by the total number of person hours spent searching the site. Information regarding the herpetofauna of the AWG was obtained from my previous survey (Gray, 2002a), the present survey (2002-2005), and interviews with individuals familiar with the herpetofauna of the Asbury Woods Greenway. Because larvae usually have low survivorship, only numbers of post-metamorphic amphibians are reported. Dead animals were noted as evidence of a species presence at the site, but were not counted in the number of animals observed.

Results and discussion

Between 1998-2005, a total of 152 person hours were spent at AWG searching for amphibians and reptiles, resulting in the observation of 582 individuals of 26 species. Two species (*Storeria dekayi dekayi* and *Rana pipiens*) reported to occur at the site (Gray, 2002) were not observed (see below). The greatest diversity of amphibians and reptiles were observed in the WCZ, with twenty-three species being found there (17 amphibian and 6 reptile) (Table 1). The diversity of habitats noted above, provide ideal conditions for a number of amphibians and reptiles. Six species *(Ambystoma jeffersonianum, Eurycea*

Table 1. The occurrence of amphibians and reptiles within each land-use zone at the Asbury Woods Greenway site, Erie County, Pennsylvania. A plus sign indicates that the species under consideration was observed or reported by a reliable source, while a minus sign indicates that the species was not observed in the respective zone. BFZ, Brown's Farm Zone; CPZ, Asbury Community Park Zone; NCZ, Nature Center Zone; WCZ, Walnut Creek Zone; NPZ, Wildlife Preserve Zone.

	Sites				
Species	NCZ	CPZ	NPZ	WCZ	BFZ
Caudata - Salamanders					
Ambystoma jeffersonianum	-	-	-	+	-
A. maculatum	+	-	+	+	+
Desmognathus fuscus	-	-	+	+	-
D. ochrophaeus	-	-	+	+	+
Eurycea bislineata	-	-	-	+	-
Hemidactylium scutatum	-	-	+	+	-
Notophthalmus v. viridescens	+	-	+	+	-
Plethodon cinereus	+	-	+	+	+
P. glutinosus	-	-	-	+	-
Pseudotriton r. ruber	-	-	-	+	-
Anura - Frogs					
Bufo a. americanus	-	-	+	+	+
Hyla versicolor	+	-	+	+	+
Pseudacris c. crucifer	+	-	+	+	+
Rana catesbeiana	-	-	+	+	-
R. c. melanota	+	+	+	+	+
R. palustris	+	+	-	+	+
R. sylvatica	+	-	-	+	+
Cryptodeira-Straightneck Turtles					
Chelydra s. serpentina	+	-	+	-	+
Chrysemys p. marginata	+	-	+	-	-
Serpentes - Snakes					
Diadophis p. edwardsii	-	-	-	+	-
Lampropeltis t. triangulum	+	+	-	+	+
Nerodia s. sipedon	+	-	+	+	-
Pantherophis alleghaniensis	+	+	+	+	+
Storeria o. occipitomaculata	-	-	-	+	-
Thamnophis s. septentrionalis	-	+	+	-	-
T. s. sirtalis	+	+	+	+	+

bislineata, Plethodon glutinosus, Pseudotriton r. ruber, Diadophis punctatus edwardsii, and *Storeria occipitomaculata occipitomaculata)* occur exclusively in this zone. A considerable amount of the forest in the WCZ is mature second growth, and has not been as extensively altered as other areas of the greenway have. Asbury Community Park (CPZ) had the lowest diversity, with two frog *(R. c. melanota* and *R. palustris)* and four snake *(Pantherophis alleghaniensis, Lampropeltis triangulum triangulum, T. s. septentrionalis,* and *T. sirtalis sirtalis)* species being found. Northern Redback Salamanders *(Plethodon cinereus)* and Allegheny Dusky Salamanders *(D. ochrophaeus)* may possibly be found in the wooded area to the north of the CPZ, as they are found in adjacent portions of the NPZ. The low number of species in the CPZ can be attributed to the limited availability of suitable habitat and the extensive recreational use of this zone. The amphibians and reptiles observed in the CPZ were most likely transients. The four snake species were all found at a large mulch pile, located in the southern portion of the CPZ. This pile is usually moist, and the decomposition of the mulch produces heat, resulting in an ideal "incubator" for reptile eggs, or a place to thermoregulate. It may also serve as a hibernaculum for some species (e.g., *P. alleghaniensis* and *T. s. sirtalis*). These two species have been observed at the mulch pile exiting a mammal burrow 21 April 2005, suggesting that the pile was used as a hibernaculum.

Salamanders were the most diverse and most numerous group, with 252 individuals of ten species being observed. The Northern Two-lined Salamander *(E. bislineata)* and the Northern Red Salamander *(P. r. ruber)* were the rarest , each with a single observation and capture rate of 0.01 (Table 2). The Northern Two-lined Salamander was last observed at this site on 13 August 1998 (1 adult and 1 larva), in an intermittent stream , just north of the power lines in the WCZ. Since that time, a housing development has replaced the old field habitat east of the stream. Additionally, runoff from storm drains has been diverted into the stream, and may have altered the hydrology or water chemistry, making the habitat unsuitable for *E. bislineata;* however, *Desmognathus spp.* still occurs along the stream bank. The low numbers of post-metamorphic Northern Red Salamanders observed may be a result of their secretive habits. It has been my experience that adult *P. r. ruber* are not encountered in large numbers, as are some other salamander species. *Pseudotriton ruber* is successfully breeding in the spring north of the oxbow (WCZ). I observed 3 larvae during the 2002-2005 sampling period, and staff at the Asbury Woods Nature Center reported observing two adults during the same period. Observations of the Northern Slimy Salamander are sparse and were restricted to the oxbow portion of the WCZ. In addition to the three individuals reported, a dead adult was found 2 September 2005, in the flood plain of Walnut Creek at the power lines. This species is reported to be resilient (Beamer and Lannoo, 2005), and in other parts of northwestern Pennsylvania, I have found it to be quite common. Perhaps it is more abundant in adjacent property to the west of the WCZ and NPZ. The most abundant salamander was the Allegheny Dusky Salamander *(Desmognathus ochrophaeus)*, with 74 individuals observed (CR = 0.49). The Allegheny Dusky was found in all surveyed zones except the NCZ and CPZ.

Nine of ten (90%) salamander species showed declines in the number of individuals observed and capture rate between sampling periods (Table 2). The declines may

be attributed to a combination of the following factors: During the 1998-2001 survey, more effort was put into searching for amphibians, especially salamanders (Gray, 2002a), while during the 2002-2005 field seasons approximately equal time was spent searching habitats for amphibians and reptiles. Thus, relatively less effort was put into searching for salamanders during the later sampling period. Also, during the 2002-2005 sampling period, more time was spent searching the WCZ, especially the floodplain. This area contains limited habitat for some of the salamander species reported to occur at the AWG. In addition, logs in several areas were frequently found turned and not replaced (especially during 2004 - 2005), resulting in loss of suitable microhabitat for salamanders. This is also an indication that individuals were looking for, and possibly, unlawfully collecting salamanders at the site. On two occasions, the author has observed people with amphibians and/or reptiles in their possession. In the first instance, two children had a bucket containing a Green Frog *(R. c. melanota)*, a Pickerel Frog *(R. palustris)*, and an Eastern Garter Snake *(T. s. sirtalis)*. In the second, an individual was observed with a Northern Redback Salamander *(P. cinereus)* in a jar. Signs at trail heads informing users of the Greenway Trail that "collecting plants, animals, or other material (living and nonliving) is prohibited" may help discourage such activity. Active patrols by staff or volunteers may also serve as a deterrent. The declines in capture rate for salamanders may also be the result of natural population fluctuations, or a response to changes in abiotic factors, such as soil moisture or temperature. The 2005 field season was unusually hot and dry, and probably forced some salamander species to stay below ground in burrows and therefore unlikely to be observed. This last point should also be taken into account when interpreting relative abundance data. For example, Dusky Salamanders *(Desmognathus spp.)* are generally found all year round in spring seeps where excessive heat and/or drying is not usually a problem. The Northern Redback Salamander *(P. cinereus)* on the other hand, is more terrestrial and may retire to underground burrows during hot and/or dry weather, resulting in a bias towards *Desmognathus spp.* Therefore, even though the Allegheny Dusky Salamander was reported as the most frequently observed, the North-

Table 2. Capture rates (# individuals observed/total time spent searching) for post-metamorphic salamanders within the Asbury Woods Greenway. An asterisk indicates a decline in capture rate between sampling periods.

	1998-2001 (72 hrs.)	2002-2005 (80 hrs.)	combined Seasons (152 hrs.)
Ambystoma jeffersonianum	0.08 (n=6)	0.02 (n=2)*	0.05 (n=8)
A. maculatum	0.49 (n=35)	0.10 (n= 8)*	0.28 (n=43)
Desmognathus fuscus	0.24 (n=17)	0.11 (n=9)*	0.17 (n=26)
D. ochrophaeus	0.58 (n=42)	0.40 (n=32)*	0.49 (n=74)
Eurycea bislineata	0.01 (n=1)	0.00 (n=0)*	0.01 (n=1)
Hemidactylium scutatum	0.11 (n=8)	0.05 (n=4)*	0.08 (n=12)
Notophthalmus v. viridescens	0.24 (n=17)	0.12 (n=10)*	0.18 (n=27)
Plethodon cinereus	0.35 (n=25)	0.40 (n=32)	0.38 (n=57)
P. glutinosus	0.03 (n=2)	0.01 (n=1)*	0.02 (n=3)
Pseudotriton r. ruber	0.01 (n=1)	0.00 (n=0)*	0.01 (n=1)

ern Redback Salamander may actually be the more abundant. A similar bias may occur in species that are active on the surface for a short period of time (e.g. *A. jeffersonianum*). The Jefferson Salamander had a capture rate of 0.05; however, if only the time spent searching during the breeding season (Feb-Apr.) is counted, the capture rate increases to 0.22. Species that form breeding aggregations at a spawning site may also seem less abundant if sampling is done outside the breeding season; the Ambystoma salamanders and most frogs fall into this group. Although frog calls were used as evidence of species presence, relatively little time was spent specifically targeting frog (or salamander) aggregations. Subsequent studies should take into consideration these biases.

The second most frequently encountered class of herpetofauna at the site were frogs, with 152 individuals of seven species being encountered (Table 3). The Gray Treefrog *(Hyla versicolor)* and the Bull Frog *(Rana catesbeiana)* were the least common anurans, with seven and five post-metamorphic individuals being found, respectively. The Gray Treefrog may be more abundant than the present report suggest, as numerous individuals have been heard calling on several occasions within the NCZ and the NPZ. In addition, larvae have been observed in the NCZ and the BFZ. *Hyla versicolor, Pseudacris crucifer crucifer*, and *R. c. melanota* all showed declines in both number of observations and capture rate of post-metamorphic individuals between surveys. These declines may be due to the same factors discussed above for salamanders. The Northern Leopard Frog *(R. pipiens)*, though reported to occur at the site (Ostrander, 2000), was not observed. This species has possibly been extirpated from the AWG. Declines of this species have been reported from other parts of the species range (Rorabaugh, 2005); however, Orr et al (1998) concluded that overall, *R. pipiens* had not declined in northeastern Ohio, and that succession was the main cause of supposed population declines in that region. This species is common at other Erie County sites. For example, McKinstry and Cunningham (1989) reported this species as abundant at Presque Isle State Park; however, Mark Lethaby (2001) has noted fewer Leopard Frogs at the park than previously observed. I found this species to be common at two sites in West Springfield, and McKinstry et al. (1999) recorded a total of twenty-four *R. pipiens* at six sites along French Creek, Erie County, Pennsylvania. The presence of multiple successional stages, as well as suitable habitat

Table 3. Capture rates (# individuals observed/total time spent searching) of post-metamorphic anurans within the Asbury Woods Greenway. An asterisk indicates a decline in capture rate between sampling periods.

	1998-2001 (72 hrs.)	2002-2005 (80 hrs.)	combined Seasons (152 hrs.)
Bufo a. americanus	0.12 (n=9)	0.36 (n= 29)	0.25 (n=38)
Hyla versicolor	0.06 (n=4)	0.01 (n= 3)*	0.05 (n=7)
Pseudacris c. crucifer	0.17 (n=12)	0.06 (n=5)*	0.11 (n=17)
Rana catesbeiana	0.03 (n=2)	0.04 (n=3)	0.03 (n=5)
R. c. melanota	0.49 (n=35)	0.15 (n=12)*	0.31 (n=47)
R. palustris	0.04 (n=3)	0.28 (n=22)	0.16 (n=25)
R. pipiens	0.00	0.00	0.00
R. sylvatica	0.07 (n=5)	0.25 (n=20)	0.16 (n=25)

for this species at the AWG site, makes it all the more surprising that a single individual has not been observed during eight field seasons. Due to this lack of sightings, I regard the Northern Leopard Frog as not occurring at the AWG site. This species is often confused with the Pickerel Frog *(R. palustris)*, which is common at Asbury. The Northern Leopard Frog can be distinguished from the Pickerel Frog by the following characteristics: the spots on the Leopard Frog are rounded, dark (usually black), with a light border; spots on the Pickerel Frog are more square, brownish, with a black border. In addition, the ground color of Northern Leopard Frogs is usually green; while Pickerel Frogs are normally tan to light brown. Anyone observing a frog within the AWG, which they believe to be a Northern Leopard Frog should try to obtain a photograph or sketch of the frogs' dorsal pattern, along with notes on the coloration, as well as specific locality data. Include your name, address, and telephone number on all material, and send the information to the author, or leave it with staff at the Asbury Woods Nature Center. The Green Frog was the most frequently observed frog (n=47; CR = 0.31), and was seen in all surveyed zones.

Snakes were represented by seven species (Table 4). An eighth species *(Storeria dekayi)* is reported to occur within the NPZ (M. Cambell, 1998, pers. com.). On 13 October 2003, a DOR Brown Snake was found on Asbury Road 0.46 mi. east of the BFZ, providing further evidence of the occurrence of the species within the Greenway. I find it interesting that I have not observed a single individual of this species from within the AWG property. Elsewhere in Erie County where this species occurs (e.g., Presque Isle; along French Creek; West Springfield; east of the Erie International Airport), it is met with rather frequently (McKinstry and Cunningham, 1989; McKinstry et al. 1999; Lethaby, 2001; and personal observations). However, at these sites, *S. dekayi* is usually found beneath cover objects, such as boards or other man-made debris which is not abundant at the AWG site. Perhaps the dearth of cover is the reason for the lack of observations of this species. Also, at least forty acres of old field habitat east of the WCZ, and south of the NPZ has been lost due to the building of a housing development. This old field habitat would have provided ideal habitat for *S. d. dekayi,* and its loss probably has contributed to the lack of recent observations. The Northern Redbelly Snake *(S. o. occipitomaculata)*,

Table 4. Capture rates (# individuals observed/total time spent searching) for the snake species within the Asbury Woods Greenway. An asterisk indicates a decline in capture rate between sampling periods.

	1998-2001 (72 hrs.)	2002-2005 (80 hrs.)	combined Seasons (152 hrs.)
Diadophis p. edwardsii	0.03 (n=2)	0.19 (n=15)	0.11 (n=17)
Pantherophis alleghaniensis	0.01 (n=1)	0.09 (n=7)	0.05 (n=8)
Lampropeltis t. triangulum	0.00	0.02 (n=2)	0.01 (n=2)
Nerodia s. sipedon	0.11 (n=8)	0.44 (n=35)	0.28 (n=43)
Storeria d. dekayi	0.00	0.00	0.00
S. o. occipitomaculata	0.00	0.04 (n=3)	0.02 (n=3)
Thamnophis s. septentrionalis	0.01 (n=1)	0.00*	0.01 (n=1)
T. s. sirtalis	0.06 (n=4)	0.45 (n=36)	0.26 (n=40)

which is occasionally found in similar situations with the Northern Brown Snake, has been observed at the site on three occasions. The Northern Ribbon Snake *(T. s. septentrionalis)*, with only a single specimen observed (CR = 0.01), was the least frequently observed snake, and the only snake species to decline in capture rate and numbers seen. A shed skin of this species was found in the CPZ at the mulch pile. The Northern Water Snake was the most abundant snake encountered at the site, with forty-three individuals being captured (Table 4). The Eastern Rat Snake *(P. alleghaniensis)* and the Eastern Garter Snake *(T. s. sirtalis)* were the most widely distributed and occurred within all surveyed zones.

Turtles were the least diverse (two species), and least observed (n=52) group at the AWG. Of the two species of Chelonia at the site, the Midland Painted Turtle *(Chrysemys picta marginata)* was the more abundant (Table 5). Fewer Common Snapping Turtles *(Chelydra serpentina serpentina)* were seen during 2002-2005, than during the prior survey. It is not surprising that *C. s. serpentina* is less abundant than the Midland Painted Turtle, as the former species is usually at the top of the food chain in the wetland habitats where it occurs. This species also does not bask on logs as often as *C. p. marginata.* However, the fact that only five individuals were observed over seven years is cause for concern. More effort needs to be put into determining the population size of this species as well as the other less common species at the AWG site.

Special mention should be made regarding the Eastern Box Turtle *(Terrapene carolina carolina)* and the Red-eared Slider *(Trachemys scripta elegans)*. An Eastern Box Turtle was found by a staff member of the Asbury Woods Nature Center in 2002 and reported to me that same year. As I reported then (Gray, 2002b), I still regard any Eastern Box Turtle found at the site as a released pet. *Terrapene c. carolina* was last collected early in the 20th century, in Erie County at Presque Isle State Park (the only known locality for this species in Erie County). The Eastern Box Turtle is believed to be extirpated from the park (Lethaby, 2002). As for the Red-eared Slider, though I have not observed any at the AWG, Scott Bloomstine (pers. com.) observed what he believed to be a Red-eared Slider in the buttonbush wetland in the NCZ. The species has been observed nearby at Presque Isle. Unfortunately, nature centers and parks are frequently used as drop-off areas for unwanted pets, thus, creating a possible threat (e.g. introduced diseases) to native amphibian and reptile populations. It is suggested that any individuals of the above two species (or any other nonnative species) found at the AWG site be reported to staff at the nature center, and effort made to remove them. It should be added that not all released pets are from extralimital species. For instance, a Midland Painted Turtle (a

Table 5. Capture rates (# individuals observed/total time spent searching) for the turtle species within the Asbury Woods Greenway. An asterisk indicates a decline in capture rate between sampling periods.

	1998-2001 (72 hrs.)	2002-2005 (80 hrs.)	combined Seasons (152 hrs.)
Chelydra s. serpentina	0.04 (n=3)	0.02 (n=2)*	0.03 (n=5)
Chrysemys p. marginata	0.31 (n=22)	0.31 (n=25)	0.31 (n=47)

species known to occur at the site) found in the oxbow in 2004 was obviously a prior captive. The specimen was found in atypical habitat and had shell abrasions and abnormal shell growth typical of a poorly maintained captive turtle. The main concerns here are: Was the turtle originally from Asbury or some other population? If not from the site, the specimen may have come from a population with a genetic makeup that is less adapted to the local environment. Another concern is whether or not the individual is harboring an infection acquired in captivity that may be spread to the native population of turtles at the site. Educating visitors of the AWG on the problems of releasing former pets at the site may aid in reducing the frequency of such activity. Pamphlets or discussion during educational programs could provide adequate routes of dissemination of such information. In summary, the twenty-six species of herptiles reported from the Asbury Woods Greenway is comparable to other sites in Erie County, Pennsylvania, considered as having significant and diverse herpetofaunas (e. g. French Creek (26 species) (McKinstry et al. 1999), and State Game Lands 314 (25 species) (Aquatic Ecology Associates, 1977; pers. obs.)., The greatest threats to herpetofaunal diversity are habitat destruction, alteration, and fragmentation (Mitchell and Klemens, 2000; Semlitsch, 2003). While these threats are unlikely within the Greenway, development of adjacent land could prove detrimental to some species, especially if their populations depend on the recruitment of individuals from outside the AWG boundaries. Obtaining conservation or recreation easements on adjacent land may be the most practical route to preserving these areas.

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Are there Hellbenders in the Potomac River? – Revisited

Norden (2006) gave an account of an old record indicating that a hellbender, *Cryptobranchus alleganiensis*, was caught by a fisherman in the Great Cacapon River, not far west of Berkeley Springs, West Virginia, which is Potomac River drainage. This record is based on a photograph in a fishing column of a Berkeley Springs Newspaper showed him by the late Robert H. McCauley. Norden (2006) gave no date for the visit with McCauley or the date of the newspaper. Mcauley (1940) did mentioned that *Cryptobranchus alleganiensis* were caught on hook and line by fisherman in the Youghiogheny River as J. T. Rothock reported to him.

Norden (2006) also mentioned a specimen caught by a fisherman, in 1995, in the Potomac River near the MD Rt. 15 Bridge at Point of Rocks, Frederick County, Maryland. It was identified by Basil Wittacker and verified by Robert Taylor according to Norden.

Harris (1975), Green (1954), Conant and Collins (1991), and Fowler (1947) indicate no published records for this species in the Potomac River Basin of Maryland or West Virginia. A species sometimes associated with the hellbender, the mudpuppy, *Necturus m. maculosus,* was also mentioned in the fishing column (Norden 2006) as sometimes caught by the fisherman. There is as, Norden (2006) mentioned, a published record for a specimen of Necturus collected from the South Branch of the Potomac River, near Rommey, West Virginia (Green, 1954).

Historically, as the fossil record has indicated (Holman, 1995, 1997), the hellbender did occur in the Potomac River "area", at Bone Cave, on Wills Mountain near Cumberland and is adjacent to the modern day Wills Creek which does drain into the Potomac River. With the amount of collecting during the last 60-65 years, turning up no specimens, the consensus, among most biologists, is that the hellbender does not now occur in the Potomac River or it's tributaries.

Fowler (1947) cited the encroachment of the Potomac River headwater streams into the adjacent Youghiogheny drainage, as mentioned by Norden (2006), as a method of possible entry. Transfer of aquatic species between these River drainage systems is well documented by Lee (1976), Stauffer et al. (1986) and Cincotta et al. (1986), again as mentioned by Norden (2006).

Norden's (2006) paper was in press, and while going through my files, I ran across a letter dated 16 March 1979 to David S. Lee, from Jim Wilkinson. David had received this letter and forwarded it to me, on 20 march 1979, for my files on distribution of Maryland amphibians and reptiles. Jim Wilkinson's states: "I read your article entitled Aquatic Zoogeography of Maryland in the winter, 1976 issue of the Atlantic Naturalist, 31(4). I was interested in your comments on the distribution and status of the Hellbender, *Cryptobranchus alleganiensis*. Since a friend and I caught one in a tributary of Watts Branch, a stream in south-central Montgomery County (Maryland)......" "The collection was made in the early 1960s at which time we did not know that the species was rare or that it should not occur in the Potomac drainage. The specimen was 6-7 inches long and was the only one found during 6 years of fishing and netting different kinds of animals in the local streams". "...I compared it with the picture in a guide to reptiles and amphibians that is part of the Golden Nature Guide series."

He was referring to Zim and Smith (1956). At the time of this letter both Dave Lee and I agreed to the comments Dave wrote on the letter when he sent it to me "Some where around fat chance (that the hellbender occurs in the Potomac River) – but thought you might want this for the herp files."

The most logical explanation for these records is not that there are breeding colonies of hellbenders or mudpuppy's in the Potomac River basin, but assuming that the identifications are correct, that they represent individuals swept down stream during heavy floods during severe storms. In an e-mail discussion with Hobart Smith (2006), his comments were "Hasn't the Potomac changed a lot since colonial times? I can well imagine the pristine river harboring creatures that could not possibly live there now. The hellbender even yet might live far upstream and be swept down in floods." Whether it was in the Pleistocene or Pre-Colonial Time the hellbender and the Mudpuppy do not appear to be indigenous now. The occasional specimens caught by fisherman

are probably examples of animals that at one point, were swept down from tributaries of the Ohio drainage into tributaries of the Potomac River, and hence into the Potomac River via heavy flooding. The last colonies of hellbenders living naturally in the Potomac River and its tributaries was probably during the Pleistocene as the fossil remains, of specimens found, indicate (Holman, 1995, 1997).

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Aggressive Behavior by the Amazon Horned Frog *Ceratophyrs cornuta*

The genus *Ceratophrys* is a sit-and-wait generalist predator often described as "aggressive" or "bad" (Duellman, 1994.). However, specific data regarding their aggressiveness are lacking; in fact, it seems that their large gape, the ability to ingest extremely large prey items in relation to their body size, and their varied diet are the cause of this reputation, rather than any behavioral characteristics. *Ceratophrys cornuta* spends much of its time buried in leaf litter, only lunging at prey items that wander by, quickly returning back to their original position (Duellman, 1994).

In January 2005, at Reserva Amazónica [formerly Cusco Amazónico], Department Madre de Dios, Peru (Duellman and Koechlin, 1991) we were conducting experiments to determine whether *Ceratophrys cornuta* ate large Orthopteran insects (ca. 45 mm body length) with large defensive spines covering their legs. Orthopterans were placed directly in front of frogs (means SV length = 9.4 cm) using hemostats and the Orthopterans were allowed to come into direct contact with the frogs. During multiple trials, 83% (n=6) reacted to the insects in an aggressive manner (Fig. 1). Frogs were originally in a "sit and wait" resting position. The frogs typically first bit the Orthopterans and released them, probably because of the spines, but the Orthopterans were allowed to continue molesting the frogs. At this point the *Ceratophrys* reared up (with all 4 limbs extended) turned 45° laterally, and lunged at the Orthopteran with an open mouth (Fig. 1). The represents the first documentation of truly aggressive behavior in *Ceratophrys cornuta*. Since frogs only demonstrated this behavior after being molsted repeatedly, they likely rely on crypsis more often than aggressiveness to avoid predators or other offensive attacks.

Figure 1. Aggressive behavior in Ceratophyrs cornuta. Frogs stood up on all 4 limbs, later jumping away from the presented food items.

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Note on Reproduction of the Striped Sandveld lizard, *Nucras tessellata* (Squamata: Lacertidae) from Southern Africa

Stephen R. Goldberg

The striped sandveld lizard, *Nucras tessellata* is endemic to the western Little Karoo, Namaqualand to southern Namibia and Botswana where it frequents rocky ground in arid savannah and karroid veld (Branch, 1998). It is a widely foraging lizard (Pianka, 1971). Information on clutch sizes is in Fitzsimons (1943), Pianka (1986), and Branch (1998). The purpose of this note is to provide additional information on the reproductive cycle of *N. tessellata* and to compare it with reproduction in other lacertid lizards from southern Africa. The first information on the testicular cycle is presented. Minimum size for reproductive activity is provided for males and females.

Fifty-eight *N. tessellata* (22 females, mean snout-vent length, SVL = 65.7 mm ± 7.0 SD, range = 54-83 mm; 28 males, SVL = 65.6 mm ± 4..4 SD, rane= 57-74 mm; 2 neonates, SVL = 29.0 ± 0.70 SD, range: 28-29 mm and 6 juveniles, SVL = 33.2 mm ± 0.75 SD, range = 32-34 mm) from southern Africa were examined from the herpetology collection of the Natural History Museum of Los Angeles County, LACM, Los Angeles, California:

Botswana, Kgalagadi District, LACM: 82708, 82710, 82712-82714, 82716, 82720, 82721, 82726, 139050.

Republic of South Africa, Northern Cape Province, LACM: 82639, 82641-82647, 82649-82655, 82657, 82658, 82661, 82663-82669, 82672- 82677, 82679, 82684, 82685, 82687- 82691, 82693, 82694, 82696-82701, 82703.

Lizards were collected by Eric R. Pianka during 1969-1970 except for LACM 139050 which was collected in 1980. Gonads were dehydrated in ethanol, embedded in paraffin, sectioned at 5 µm and stained with Harris hematoxylin followed by eosin counterstain. Enlarged ovarian follicles (> 4 mm length) were counted; no histology was done on them. Oviductal eggs were previously removed; their mean value is in Pianka (1986). Male and female mean body sizes (SVL) were compared with an unpaired *t* test using Instat (vers. 3.0b, Graphpad Software, San Diego, CA).

There was no significant size difference between adult males and females (unpaired *t* test, $t = 0.068$, $df = 48$, $P = 0.95$). Data on the testicular cycle is presented in Table 1. Although samples were not available from all months, it is clear that sperm formation (lumina of seminiferous tubules lined by rows of metamorphosing spermatids and sperm) occurred in late spring-summer. The months when spermiogenesis begins and ends is not known. The significance of one male with regressed testis in February (seminiferous tubules are reduced in size and contain spermatogonia and Sertoli cells) or two males in January with testes in recrudescence (renewal of germinal epithelium for next period of sperm formation; primary and secondary spermatocytes predominate) require examination of additional samples. The smallest reproductively active male measured 57 mm SVL and was from February (LACM 82703). The testicular cycle of *Nucras tessellata* is similar to that of the other African lacertids, *Pedioplanis namaquensis, Pedioplanus lineoocellata*, and *Meroles cuneirostris* (Goldberg 2006a, 2006b; Goldberg and Robinson 1979) in that sperm formation also occurs in spring-summer. It differs from the testicular cycle of *Pedioplanis burchlli* (Nkosi et al., 2004) in which all testes were involuted (regressed) in February.

Stages in the monthly ovarian cycle of *N. tessellata* are in Table 2. Reproductively active females were present from December to February. The exact duration of female reproduction is not

Table 1. Monthly distribution of reproductive conditions in the seasonal testicular cycle 0f 28 *Nucras tessellata* from southern Africa. Values are the numbers of males exhibiting each of the three conditions.

Month	*n*	Regressed	Recrudescence	Spermiogenesis
November	3	0	0	3
December	2	0	0	2
January	11	0	2	9
February	12	1	0	11

Table 2. Monthly distribution of reproductive conditions in seasonal ovarian cycle of 22 *Nucras tessellata* from southern Africa. Values shown are the numbers of females exhibiting each of the three conditions.

Month	*n*	No yolk deposition	Early yolk deposition	Eggs > 4 mm length
November	1	1	0	0
December	4	2	1	1
January*	8	7	0	0
February	8	4	0	4
March	1	1	0	0

* One January female contained squashed oviductal eggs that could not be counted.

known due to lack of spring and autumn samples. Mean clutch size for five *N. tessellata* clutches (enlarged follicles > 4 mm) was 2.8 ± 0.84 SD, range: 2-4. Fitzsimons (1943) reported *N. tessellata* laid clutches of four eggs; Branch reported 3-4 eggs were laid. Pianka (1986) reported a mean clutch of 3.3 ± 0.66 SD for 8 *N. tessellata* females. Clutch sizes of two eggs (LACM 82639, LACM 82691) from December and February, respectively, are new minimum clutch sizes for *N. tessellata*. The smallest reproductively active female (enlarged follicles > 4 mm) measured 63 mm SVL (LACM 82639) and was from December. The presence of reproductively active *N. tessellata* females from summer may suggest a similar season of reproduction as in other southern African lacertid species including *Meroles cuenirostris* (Goldberg and Robinson, 1979); *Pedioplanis burchelli* (Nkosi et al. 2004); *Pedioplanis namaquensis* (Goldberg, 2006a); *Pedioplanis lineoocellata* (Goldberg, 2006b); which were also reproductively active during summer.

Two presumably neonates of *N. tessellata* (SVL 28, 29 mm) were collected in January. The collection of six other *N. tessellata* in the 30-35 mm range in January-February were likely born previously in spring suggesting the reproductive period of *N. tessellata* was underway at that time.

With 37 species of lacertid lizards in southern Africa (Branch 1998), subsequent investigations on other lacertids will be needed to ascertain the variation in reproductive cyceles of the lacertid lizards of southern Africa.

I thank Christine Thacker (LACM) for permission to examine *N. tessellata.*

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Note on Reproduction of Wahlberg's Kalahari Gecko, *Colopus wahlbergii* (Squamata: Gekkonidae) from Southern Africa

Stephen R. Goldberg

Wahlberg's Kalahari Gecko, *Colopus wahlbergii* frequents sandy plains with scattered vegetation and ranges from the Kalahari region of Botswana, extending into the Northern Cape region of the Republic of South Africa, Namibia and southwest Zimbabwe in southern Africa (Branch, 1998). It is strictly nocturnal and somewhat rare (Fitzsimons, 1943). The purpose of this note is to supply information on reproduction in *C. wahlbergii* from a qualitative histological examination of gonadal material from museum specimens.

Seventy-one *C. wahlbergii* (32 females, mean snout-vent length, SVL = 53.1 mm ± 3.1 SD, range = 48-58 mm; 39 males, SVL = 45.2 mm ± 3.3 SD, range = 40-52 mm) from southern Africa were examined from the herpetology of the Natural History Museum of Los Angeles County, LACM, Los Angeles, California: Botswana, Kgalagadi District: 116404-116407, 116409, 116411-116416, 116418, 116422-116431, 116434-116436, 116439, 116440, 116442, 116448, 116453, 116454, 116457-116462, 116464-116484, 116486,116487.

Republic of South Africa: Northern Cape Province: 116489, 116492, 116496, 116499-116501, 116508, 116511, 116515, 116517, 116519.

Lizards were collected during 1969-1970 by Eric R. Pianka. Gonads were dehydrated in ethanol, embedded in paraffin, sectioned at 5 µm and stained with Harris hematoxylin followed by eosin counterstain. Enlarged follicles (> 3 mm length) were counted; no histology was done on them. Oviductal eggs were previously removed; their mean value is in Pianka (1986). Male and female mean body sizes (SVL) were compared with an unpaired t test using Instat (vers. 3.0b, Graphpad Software, San Diego, CA).

Data on the testicular cycle is in Table 1. Although samples were not available from all months, it is clear that sperm formation (spermiogenesis) occurred in spring and summer. The presence of males with regressed testes (seminiferous tubules reduced in size and contain mainly spermatogonia and Sertoli cells) in February and April and males with testes in recrudescence (proliferation of germ cells in seminiferous tubules for the next period of spermiogenesis, primary, secondary spermatocytes predominate) in February, April and May suggests that the current cycle of spermatogenesis ends and recovery for the next cycle both occur in autumn. Examination of additional specimens will be required to verify this hypothesis. The smallest reproductively active male (spermiogenesis in progress) measured 40 mm SVL (LACM 116481) and was collected in October.

Female *C. wahlbergii* were significantly larger than males (unpaired t test, $t = 10.2$, $df = 69$, $P < 0.0001$). Stages in the seasonal ovarian cycle of *C. wahlbergii* are presented in Table 2. Reproductively active females were present in January, February, September and October. Due to lack of female samples from all months, the duration of the female reproductive cycle is not known. Mean clutch size for 11 gravid *C. wahlbergii* was 2.0± 0.0 SD. Pianka (1986) reported a mean clutch size of 2.0 ± 0.0 SD for 17 *C. wahlbergii* females. Branch (1998) reported two eggs were laid in a clutch. Most gecko species produce two eggs in a clutch (Henkel and Schmidt, 1995). Pianka and Huey (1978) reported female *C. wahlbergii* with eggs in their oviducts from January. The presence of one female from January (LACM 116428) with two enlarged ovarian follicles (> 3

Table 1, Monthly distribution of reproductive conditions in the seasonal testicular cycle of 39 *Colopus wahlbergii* from southern Africa. Values are the numbers of males exhibiting each of the three conditions.

Month	*n*	Regressed	Recrudescence	Spermiogenesis
January	10	0	0	10
February	4	2	1	1
April	3	1	2	0
May	1	0	1	0
August	1	0	0	1
September	9	0	0	9
October	8	0	0	8
November	1	0	0	1
December	2	0	0	2

Table 2. Monthly distribution of reproductive conditions in the ovarian cycle of 32 *C. wahlbergii* from southern Africa. Values shown are the numbers of females exhibiting each of the five conditions. Oviductal eggs were previously removed; their mean value is in Pianka (1986).

Month	*n*	No yolk deposition	Early yolk deposition	Follicles >3 mm length	Corpora lutea	Follicles > 3 mm and early yolk deposition
January	12	4	1	5	1	1
February	7	6	1	0	0	0
March	1	1	0	0	0	0
April	4	4	0	0	0	0
September	2	0	1	1	0	0
October	6	2	0	4	0	0

mm) and early yolk deposition (basophilic vitellogenic granules) in a markedly smaller follicle (1.5 mm) for a later egg clutch indicated *C. wahlbergii* females may produce more than one clutch in the same reproductive season. The smallest reproductively active female (enlarged ovarian follicles > 3 mm) measured 48 mm SVL (LACM 116467) and was collected in September.

Looking at the reproductive cycles at other geckos from southern Africa, peak reproductive activity for both sexes of *Ptenopus garrulus* was in September and October (spring); clutches were limited to one egg (Hibbitts et al., 2005). More than one clutch can be laid in a reproductive season (Hibbitts et al., 2005). Males of *Pachydactylus bibronii* exhibited peak spermiogenesis from July-November (mid-winter to late spring) (Flemming and Bates, 1995). Females undergoing yolk deposition were found from June to January (winter to mid-summer); clutches contained two eggs; some females produced two clutches in the same reproductive season (Flemming and Bates, 1995).

Subsequent investigations on reproduction in additional geckonid species will be needed to ascertain variations in the reproductive cycles exhibited by members of the Geckonidae from southern Africa.

I thank Christine Thacker (LACM) for permission to examine *C. wahlbergii.*

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Response of *Plethodon cinereus* to Chemical Cues from Different Numbers of Conspecifics

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Abstract

The red-backed salamander, *Plethodon cinereus*, is a species that generates and responds to chemical cues. Such cues can affect interactions among conspecifics. We studied the response of adult male and female *P. cinereus* to cues from different numbers of conspecifics using pairwise choice experiments. Females tended to avoid substrates containing cues from five conspecifics as opposed to one or zero, whereas males made no distinction. The sex of the donor salamander had no effect on substrate choices. Our results indicate that there are differences in how males and females respond to cues about the density of conspecifics.

The response of the red-backed salamander, *Plethodon cinereus* Green, to varying chemical signals affects interactions within this species and influences their distribution and population density within a given habitat (Tristram, 1977). *Plethodon cinereus* use chemical signals to gain information about both heterospecific and conspecific salamanders and neighboring territories (e.g., Jaeger *et al.*, 1986; Mathis, 1990; Graves, 1994; Martin *et al.*, 2005), as well as assess prey availability (Placyk and Graves, 2002; Karuzas *et al.*, 2004) and predation risk (e.g., Madison *et al.*, 1999; Sullivan *et al.*, 2002, 2003, 2004). However, it is not clear how these salamanders respond to cues from different numbers of conspecifics (i.e., whether they will prefer substrates with cues from many conspecifics or substrates with no or few cues).

We examined the response of adult male and female *P. cinereus* from a population in central Ohio to the chemical cues of different numbers of conspecifics (0, 1, or 5 individuals). Field and laboratory observations of the *P. cinereus* in this population suggest that the salamanders are not territorial. For example, we have observed up to 13 salamanders under a single cover object (G.R. Smith, unpubl. data), and adult males show no territorial behavior in staged encounters in the laboratory (A.A. Burgett and G.R. Smith, unpubl. data). We therefore predicted that there would be little if any response to the different numbers of conspecifics if territoriality is driving the choice of individual salamanders. However, if individual salamanders are choosing or avoiding marked substrates for other reasons, such as avoiding competition (e.g., prefer substrates with cues from fewer competitors), we might expect a preference for fewer conspecifics, especially among females who may have greater energetic demands due to egg production and brooding (Yurewicz and Wilbur, 2004), or who may seek to avoid harassment by courting males (e.g., Rohr *et al.*, 2005).

Materials and Methods

Adult *P. cinereus* were collected from secondary growth forest, under natural and artificial cover objects, at the Denison University Biological Reserve, Licking Co., Ohio during October 2003, the start of the breeding season in *P. cinereus*. Salamanders were sexed by candling (Gillette and Peterson, 2001). All salamanders were adults, and no females were observed guarding nests when collected.

In the laboratory, we transferred salamanders to 12 clear, plastic boxes (30 cm x 15 cm x 12 cm) on a substrate of several pieces of damp 15cm filter paper, each piece cut in half (i.e., to

make a semi-circle). Four of the boxes contained 1 salamander each (2 boxes containing males, 2 containing females); another four boxes housed 5 salamanders (2 containing 3 males and 2 females, and 2 containing 2 males and 3 females); and the final four boxes housed no salamanders (controls). These numbers of donor salamanders were chosen because they reflect numbers of salamanders that might be expected to be commonly encountered in nature by individual *P. cinereus* in this population. Salamanders housed in the boxes served as donor salamanders and were maintained at approximately 17-19°C. Salamanders were not fed, but we misted the salamanders and filter paper with water once a day (including the control containers). Donor salamanders were housed for 5 d, and then returned to the location from which they were collected.

We performed experiments on 6, 12, and 19 October 2003. After 5 d, we removed donor salamanders from the plastic boxes. Following the removal of feces, we transferred the filter paper to 15 cm diameter petri dishes. Three choice experiments were set up using the petri dishes: 0vs1, 0vs5, and 1vs5. For each petri dish in the 0vs1 combination, we placed a piece of filter paper from a blank (control) box on half of the petri dish and filter paper from a box holding one donor salamander on the other half of the petri dish. The same procedure was used for the 0vs5 and 1vs5 combinations using filter paper from the appropriate donor boxes. We then misted the dishes with water and transferred one test salamander, collected earlier that day (at least 8 – 10 h earlier), to each dish. Donor and test animals were collected from different areas of the Denison University Biological Reserve to reduce possible familiarity among salamanders that might influence their behavioral responses (e.g., Guffey *et al.*, 1998; Jaeger and Peterson, 2002). A total of 117 salamanders was used as test salamanders over the course of the study, with 51 males and 66 females tested.

Table 1. Responses of red-backed salamanders, *Plethodon cinereus*, to the cues from varying numbers of conspecific salamanders. Numbers of salamanders choosing the area with cues from the lower and higher number of donor salamanders are given for each experimental condition (see text for explanation of experimental set-up).

	0 vs 1	0 vs 5	1 vs 5
All salamanders			
Lower 16	25	26	
Higher	26	13	11
Females only			
Lower	8	17	15
Higher	16	5	5
Males only			
Lower	8	8	11
Higher	10	8	6

Fifteen minutes after salamanders were introduced into the test petri dish, we began observing the salamanders, recording their position every 5 minutes for 1 hour. We recorded position according to the side of the petri dish where the majority of the salamander's body was located. If the salamander's body was evenly divided between the two sides of the petri dish, we recorded the side with the head as the chosen side. Tests were conducted from 2200h to 2400h, with shades closed and lights off (observations of salamanders were made using indirect lighting from a flashlight). *Plethodon cinereus* is nocturnal and responds to chemical cues more strongly in the evening than during the day (Madison *et al.*, 1999). Petri dishes were randomly oriented and located on a laboratory bench. Salamanders collected for testing became the new donor salamanders for the following week's test.

For statistical analysis, we first determined whether an individual salamander avoided or preferred the side with the cues from the highest number of donor salamanders. "Avoidance" was assigned if the salamander used the side with the cues from the highest number of donor salamanders < 50% of the time, and "Preference" was assigned if the salamander used the side with the cues from the highest number of donor salamanders > 50% of the time (see Madison *et al.*, 1999; Sullivan *et al.*, 2004). We then used a series of Chi-square analyses to examine the effects of the independent variables on the responses of the test salamanders. We used a sequential Bonferroni correction on the χ value to account for multiple statistical tests on a single dataset, and all results referred to as significant were statistically significant following this correction.

Results

The sex of the donor in the 0vs1 experiment had no effect on the behavior of males ($\chi_1^2 = 3.54$, $P = 0.060$) or females ($\chi_1^2 = 0.076$, $P = 0.78$). Likewise, the make-up of the donors in the 5 salamander groups (i.e., 2 males:3 females vs. 3 males:2 females) did not affect the behavior of males ($\chi_1^2 = 0.022$, $P = 0.88$) or females ($\chi_1^2 = 3.38$, $P = 0.07$). We therefore pooled across donor sex and donor group compositions in all subsequent analyses.

Overall, salamanders tended to prefer the side with cues from the highest number of donor salamanders in the 0vs1 experiments, but they avoided the side with cues from the highest number of donor salamanders in the 0vs5 and 1vs5 experiments (Table 1; $\chi_2^2 = 9.99$, $P = 0.0068$). This pattern held true when only females were analyzed (Table 1; $\chi_2^2 = 11.77$, $P = 0.0028$), but not when only males were analyzed (Table 1; $\chi_2^2 = 1.52$, $P = 0.47$).

Discussion

Plethodon cinereus tended to avoid areas containing odors from five conspecifics, preferring areas marked by either one or zero conspecifics, but when given the choice between areas containing cues from 0 or 1 individual, they tended to prefer the area with the cues from a single individual. However, we found that it was only females that showed this response. Male *P. cinereus* showed no differences in preferences between the experimental conditions, which is consistent with the lack of territorial behaviour among males we have observed for this population (A.A. Burgett and G.R. Smith, unpubl. data).

Our results suggest that female *P. cinereus* in this population are able to differentiate among substrates marked by cues from varying numbers of conspecifics, and that there is a tendency to avoid substrates marked by larger numbers of conspecifics. It may be that females are simply avoiding areas with a higher concentration of social chemical cues. For example, female *N. viridescens* avoid large groups of males, presumably because they can reduce the cost of courtship that might occur in the presence of several males (Rohr *et al.*, 2005). Alternatively, the salamanders may be

avoiding areas with alarm cues that may be released during physical interactions between conspecifics (i.e., during biting or other physical interactions in the "donor" boxes). Indeed, Sullivan *et al.* (2003) found that *P. cinereus* avoid areas with cues from injured conspecifics. Male *Notophthalmus viridescens* will avoid chemical cues from injured conspecifics but this avoidance is lessened by the presence of cues from females during the breeding season (Rohr and Madison, 2001; see also Rohr *et al.*, 2002, 2003), thus a similar response in *P. cinereus* could explain the difference between males and females in our study. Finally, females may be avoiding competition for food. Females may be more "choosy" about the number of potential competitors than males because females use a great deal of energy on egg production and brooding (Yurewicz and Wilbur, 2004).

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REPORT ON AN ALBINO TEXAS BROWNSNAKE (*STORERIA DEKAYI TEXANA*) FROM SOUTHERN TEXAS

Abstract

On 13 March 2005, an albino *Storeria dekayi texana* was collected in Kleberg County, Texas. This is the first albino specimen of *S. dekayi* reported from Texas.

Resumen

El 13 de marzo del 2005, un albino *Storeria dekayi texana* fue encontrado en el condado de Kleberg, Texas. Este es el primer espécimen albino de *S. dekayi* reportado en Texas.

North American Brownsnakes, *Storeria dekayi* (Holbrook, 1836) are small (23-33 cm) secretive ground dwelling snakes (Conant and Collins 1998). Their range includes most of the eastern United States southward through the eastern half of Texas along eastern Mexico to Guatemala and Honduras (Christman 1982).

At 2030 h on 13 March 2005 a female *Storeria dekayi texana* (Texas Brownsnake) was collected in Kleberg Co., Texas, city of Kingsville, .15 km southwest of the junction of state highway 141 and S Wanda Drive (N 27° 30.853 W 097° 52.821). Normal red and yellow skin colors were present however; the specimen lacked all black pigment. Aside from atypical coloration the specimen was otherwise unremarkable. The specimen was deposited in the Texas Natural History Collections, Texas Memorial Museum (specimen # TNHC 63933, 208 + 58 mm TL).

Aberrant color variations including albinism are well documented in reptiles (Dyrkacz 1981; Bechtel 1995). There are 2 previous reports of albinism occurring in *Storeria dekayi*, both from specimens collected in Illinois (Smith 1961; Thrall 1971). However, no additional reports of albino *Storeria dekayi* have been documented. This is the first reported albino specimen of *Storeria dekayi* found within Texas.

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Salienta Ghost Road Skins

I have been driving local roads, in Anne Arundel County, Maryland, looking for amphibians and reptiles every day during the expected season at about 7:00 pm, and on days when I am off, again at about 11:00 am. On 16 July 2005, at 11:00 am while driving these roads, I noticed something that I am not sure I have noticed before. Without the high humidity, it would probably not be noticeable to the extent it was this morning. All road surfaces were wet, although it was a period of overcast skies and no drizzle. There have been several days of thunderstorms, varying between light rain, heavy downpours, and periods of just heavy overcast skies. At 11:00 am this morning, it was overcast 81 degrees and the humidity was 89 %.

First, I found a green frog (*Lithobates clamitans melanota*) skin on the road surface. No meat, no bones, just a torn but pliable and identifiable pigmented translucent skin. Twenty minutes later on a different road, I found a Fowler's Toad (*Anaxyrus fowleri*) skin. Again, no meat, no bones, only a torn pliable identifiable pigmented translucent skin.

Due to the high humidity the skins were very pliable and could be stretched to reveal the dorsal pattern of each. I have found both fresh and dry DOR frogs and toads before, where either the whole animal or at least bones and dry skin, were identifiable.

My first thought was "is it possible, that these were DOR's that were eaten by a mammal or bird, and the epidermis regurgitated?" I (Harris, 1970) remember having *Rattus norveqicus* skins passed intact, by a captive *Andrias davidianus*. I began seeing frog and toads skins everywhere on the roads in the loop I normally drive. I even started communicating with biologists every where asking if anyone else had seen this phenomenon. There were no explanations at hand, just more and more frog and toad skins. The general consensus was that predation was probably not the answer.

After much observation a possible explanation for the empty frog and toad skins occurred to me and may be as follows. On the morning, of the 15 July, at about 4:00 am there was a very strong thunderstorm and a heavy downpour. It was one of the heaviest I have seen. Frogs and toads would get flattened when run over and stick to the road between the rain events. Could the heavy downpour be responsible for washing out the entrails from the torn outer epidermis, which is stuck to the road surface? Since the really heavy downpour did not last long, the water may not have had the time to completely loosen the skins themselves.

I would like to thank Hobart M. Smith as he encouraged me to report this phenomena. Also, I would like to thank all others who responded to my e-mails, including, but not limited to, John E. Cooper, William L. Grogan, David S. Lee, Daniel J. Lyons, Joe McSharry, Robert Miller, Arnold Norden, William Sipple, Hobart M. Smith and John Zyla.

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Some Natural Occurring Fatalities in Maryland Amphibians and Reptiles

While going through my field notes for the years 1957 until the present, I noticed several comments concerning dead amphibians and reptiles encountered in the spring, while checking transient ponds. I have checked various transient ponds every spring making observations on adult *Ambystoma t. tigrinum, A. jeffersonianum* and *A. maculatum* breeding there. I have also checked on the status of larval *A. opacum.*

The first observation recorded in my field notes was of a dead adult *Lithobates sylvatica* found on its back at one end of a dry transient pond bed on 6 January 1962 about 2 mi W LaPlata, Charles County, Maryland. There were evidence of rain as there were puddles in the immediate area, none however, in the pond bed. Temperature was 50 degrees at 11:00 pm.

A dead adult *Lithobates clamitans melanota* was found submerged in a small cement pond on a hilltop off Chemical Road in Curtis Bay, Baltimore City, Maryland on 24 March 1962. At 9:00 pm, temperatures were between 54-58 degrees. *Pseudacris c.crucifer* were recorded calling in the area. The *P. c. crucifer* started calling that day about 5:00 pm and stopped at about 10:00 pm.

On 7 February 1963, while removing sheets if ice (20-45 mm thick) from a transient pond 2 mi W LaPlata, Charles County, Maryland, two dead A. tigrinum laying on their backs, were found among a total of sixty-eight specimens collected. Collection took place from 7:00 pm to 10:30 pm. Air temperature was 40 degrees, while water temperature was 33 degrees. Salamander body temperature recorded was 32.9 to 33.44 degrees. The two dead specimens are catalogued AS 214 HSH/RSS (NHSM) and AS 215 HSH/RSS (NHSM).

On 26 March 1963, at about 11:00 pm, in a transient woods pond, I found two dead adult *Sceloporus u. hyacinthinus* submerged about 10 inches below the waters surface. The temperature was approximately 45-50 degrees. The pond was about 1 mi SE Mountain Road on Pinehurst Road, Anne Arundel County, Maryland. The specimens appeared to have been hibernating there and drowned when the spring rains filled the area. The preceeding weeks of fluctuating temperatures may have played a role. *Scaphiopus holbrookii*, *Pseudacris c. crucifer* and *Lithobates sylvatica* were breeding in the area. Cooper (1956a) mentions amphibians and reptiles utilizing deep puddles, in areas that normally, at some point contain water for hibernation sites, and perhaps that was what was happening here.

On 4 March 1966, at about 10:00 pm, in a transient field pond. off Earnestville Road, near Big Pool, Washington County, Maryland, I found a dead adult *Plethodon cinereus* submerged several inches below the water surface. This specimen appears to have drowned, however, the preceding week of fluctuating temperatures may have played a role. Cooper (1956b) discusses aquatic hibernation in *P. cinereus*, and the role of aquatic versus terrestrial hibernation in this species. Air Temperature was 55 degrees, and water temperature was 51 degrees. *Preudacris c. crucifer* were calling, and *A. jeffersonianum A. maculatum* and *Notophthalmus v. viridescens* were observed. *A. jeffersonianum* eggs, believed to have been deposited the night before, were also found.

On 4 September 1966 at 10:00 am, while collecting in a large box spring, I found an adult Gyrinophilus p. porphyriticus lying on its back, under the water, near death (died later that morning). It had a tumor on its head. This box spring was located about 2 mi N Maple Glade Road on Cranesville Road, Garrett County, Maryland. This specimen is catalogued as AS 423 HSH/

RSS(NHSM).

In all the specimens mentioned above, there was no apparent cause of death. I assumed in the terrestrial species found under water that the cause was drowning, but since amphibians and reptiles may choose aquatic sites for hibernation (Cooper, 1956a,b) fluctuating temperatures may be involved. In the G. p. porphyriticus, I assumed the cause was due to the tumor.

In the terrestrial setting, while collecting material, I have recorded only two cases. On 15 September 1966, while collecting in the Moss Fields off Maple Glade Road, Swallow Falls State Park, Garrett County, Maryland, I found a dead adult specimen of *Eumeces anthracinus* under a rock. A live juvenile *Diadophis p. edwardsi* was under the same rock. The *E. anthracinus* appeared to have recently died...possibly squashed. There is a note in my field notes mentioning possible pesticides as some spraying was taking place in the area. There was no odor and the specimen was pliable. It is catalogued RL 247 HSH/RSS (NHSM).

On 8 June 2006, I found a juvenile *Nerodia sipedon sipedon* which appeared to have been freeze dried. The specimen, 21.1 cm, was found on a paved parking lot, next to a fence, at the rear of the Millersville Post Office, Millersville, Maryland. Apparently from last year's brood, the specimen was found in a crawling position, and appeared normal, except for the fact it was completely dried. On handling the specimen snapped in half expelling minute tissue particles. The snake apparently died from dehydration/starvation. (Ed. Note: Last paragraph added while in press).

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Scanning Electron Microscopy: Scale Topography in *Crotalus* and *Sistrurus* Revisited

Harris (2005) summarized his 1975 work examining the dorsal scales of *Crotalus* and *Sistrurus,* while inadvertently missing an important paper (Stille, 1987) on the same subject. Even so, the agreement is conclusive, in that of the material examined, three stand out from the rest *Crotalus horridus, C. stejnegeri* and *Sistrurus miliarius.*

Stille (1987) pointed out the fact that less pronounced convex structures can be seen in *C. durissus, C. enyo, C. unicolor, C. vegrandis,* and to some extent also in *C. lannomi* and *C. stejnegeri.* In this I concur and can add the ones I observed *C. d. durissus, C. d.cascavella, C. d. collineatus, C. terrificus, C. d. tzabcan, C. h. horridus, C. h. atricaudatus, C. e. enyo, C. e. cerralvensis, C. e. furvus, C. unicolor and C. vegrandis.* Harris (2005) did not report this phenomon, as I was not sure if what I was seeing was real or an artifact of sample preparation.

Raised cell boundaries poses an interesting point. Many of the scales I examined did have raised cell boundaries. Additionally, on many scales, several cell layers were visible. The bottom or lower cells always had fissural boundaries, while the top or upper cells had raised cell boundaries. This finding versus what Stille (1987) observed may well be explained by sample preparation. Incidentally, we both sampled the exact same area of the scale. My samples were washed with distilled water and then air-dried. Stille (1987) went through an elaborate procedure,

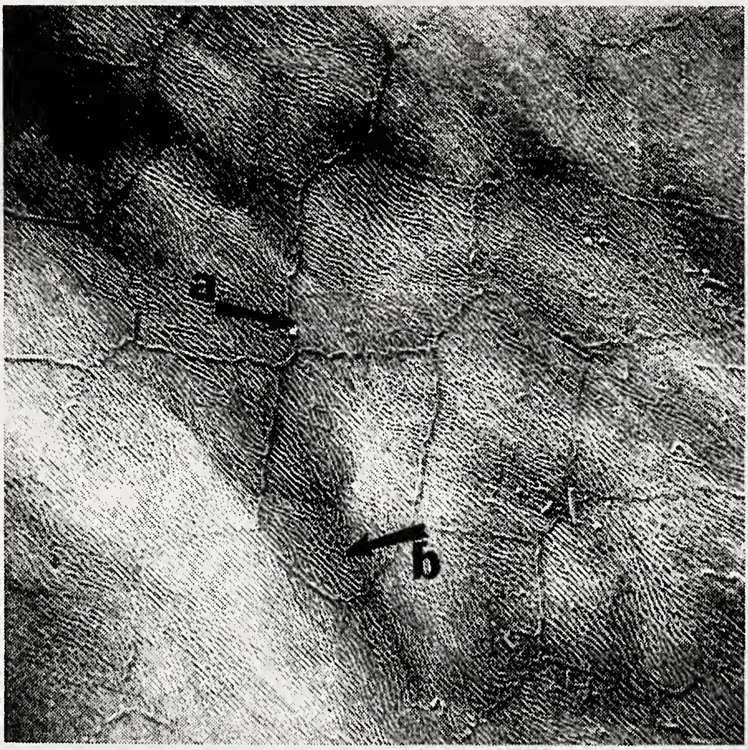

Figure 1. A SEM of a *Crotalus b.basiliscus* scale (1000X) showing two cell layers, an example of a raised cell boundary (a) and below it, a fissural cell boundary (b) (75-18).

including ultrasonic cleaning during the first two washes. This technique may have loosen and removed the outer scale layers, leaving only the fissural boundaries he observed. In the case of C. pricei, where he did observe the raised cell boundary, it may have been at the point of development where it was firmly attached and not washed away. Figure 1. Shows an example of two cell layers, with the bottom or lower being fissural and a top or upper having raised cell boundaries.

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SNAKES OF THE AMERICAS: CHECKLIST AND LEXICON, by Bob L. Tipton. 2005. Krieger Publishing Company, Melbourne, Florida. 492 pp. Cloth & CD ROM $94.50. ISBN 1-57524-215-X

This volume certainly will be a wonderful addition supplementing and updating any previous works by Peters and Orejas-Miranda (1970), Smith and Smith (1973, 1976, 1993, Frank and Ramus (1995), McDiarmid, Campbell and Touré (1999).

While the author considers himself an amateur herpetologist, this scholarly and highly intellectual tome certainly should prove differently. The author has traveled throughout the world, and has compiled an remarkable pile of literature as shown in the extensive literature cited section covering some 80 pages and over 3000 references.

The author had originally planned on compiling the lexicon with only about 3000 to 4000 common names cross-referenced to scientific names, whereas the finished product contains over 21,000 common names in a wide variety of languages. The checklist has certainly been a massive achievement, and will prove extremely important for anyone doing systematic work on any genera, species or subspecies found within the new world.

This volume also includes a CD which addresses the common names found within the literature, or used by native people from throughout the range of each species.

The author has not agreed with numerous current standard and scientific names found in Crothers et al. (2000), and other publications for Mexican, Central American and South American species. It's a shame that his literature search was discontinued that same year, as several major publications have appeared during this interim which would have added greatly to this outstanding volume.

We provide comments on genera and species-subspecies from the United States which the author differs from Crothers et al. (2000) or other authors who have made suggestions on the systematics of any given species. Comments are also made on certain species from south of the border when deemed highly relevant. The genera *Charina* and *Lichanura* have drawn considerable attention, although are considered separate genera. The author feels *Lichanura* requires further study and recognizes seven subspecies of *L. trivirgata*, although several subspecies including *L. t.arizona, L. t. bostici, L. t. gracia,* and *L. t. saslowi* are questionable. The author recognizes the genus *Arizona* as consisting of nine subspecies under the single species *A. elegans*, whereas Crothers et al. (2000) cited only seven, and Collins and Taggart (2002) recognized the three subspecies *A. e. arenicola, elegans and philipi* with the other four subspecies *A. e. candida, eburnata, noctivaga* and *occidentalis* as subspecies of *A. occidentalis.* The genus *Bogertophis* is retained even though Schultz (1996) failed to recognize same, whereas both Crothers et al. (2000) and Collins and Taggart (2002) recognized same.

In the subfamily Erycinae, *Charina bottae utahensis* was suggested as not valid (Stewart 1977), but the author recognized same as a valid subspecies. The author recognized *Conophis pulcher,* which was synonymized with *C. lineatus* by Wilson and Meyer (1985). The later authors failed to recognize subspecies of *C. lineatus* whereas the author recognized *C. l. lineatus, C. l. concolor* and *C. l. dunni.* The author recognized eight subspecies of *Drymarchon corais*, whereas Crothers et al. (2000) fail to recognize any subspecies, while Collins and Taggart (2002) recognize *D. erebennus* as a distinct subspecies. The author followed Crothers et al. (2000), except for recognizing *Elaphe guttata emoryi,* although it would have been nice if he had cited Burbrink (2002) in which a new species, *E. slowinskii* was described. The author follows Walley and Eckerman (1999)

in not recognizing *H. n. gloydi*, whereas he follows Crothers et al. (2000) and Collins and Taggart (2002) arrangement for *Hypsiglena*, *Lampropeltis*,and *Leptodeira*. The genus *Liochlorophis* is followed rather than *Opheodrys* for *vernalis*, and the author recognizes four species, whereas Crothers et al. (2000) recognized only *carinatus* as a valid subspecies of *vernalis* while still assigning *vernalis* as a species under *Opheodrys*, while Collins and Taggart (2002) fail to recognize any subspecies and retained *Liochlorophis* as the valid genus. In the genus *Phyllorhynchus* the author recognizes ten subspecies, whereas both Crothers et al. (2000) and Collins and Taggart (2002) fail to recognize subspecies. McDiarmid and McCleary (1993) and McCleary and McDiarmid (1993) were not convinced that subspecies should be recognized, while the author lists subspecies on the basis that McDiarmid and McCleary cited same, but felt it might not be justified. The author follows Rodriguez-Robles & Jesús-Escobar (2000) classification of the genera *Pituophis*. In the genus *Regina*, *Rhadinaea*, *Salvadora*, *Seminatrix*, *Senticolis*, *Sonora*, *Stilosoma*, *Storeria* and *Tantilla*, the author follows the above noted author classification. It is noteworthy that in the genus *Sonora* the author follows Werler and Dixon (2000) in recognizing *S. s. taylori*, whereas Frost and Van Devander (1979) fail to recognize subspecies in the genus *Sonora*. In the genus *Thamnophis* the author recognizes *T. elegans arizonae*, whereas neither Crothers et al. (2000) nor Collins and Taggart (2002) recognize this subspecies. Comments are also made regarding the validity of *T. sirtalis infernalis*. The genus *Trimorphodon* follows Crothers et al. (2002) closely, but still recognizes *T. vandenburghi* even though this species was synonymized with *T. b. lyrophanes* by Grimers et al. (1994). We are rather surprised to see that the author recognizes all four subspecies of *Tropidoclonion* whereas neither Crothers et al (2000) .or Collins and Taggart (2002) support same.

In the Elapidae, the author follows Roze (1996) in recognizing *Micrurus fulvius tenere* as a subspecies, whereas other authors recognize *M. tener* as a distinct species. The author recognizes *Crotalus horridus atricaudatus* even though this subspecies was synonymized by Pisani et al. (1973) and Collins and Knight (1980) in the Crotalidae, and Clark et al. (2003) using mtDNA analysis fail to recognize *atricaudatus*. Crothers et al. (2000) commented on the status of *Crotalus ruber* and follow Grismer et al. (1994) in synonymizing *ruber* with *exsul*, whereas Collins and Taggart (2002) recognized *ruber* as a distinct species and the author recognized *ruber* as a distinct species until a decision is made by the International Code of Zoological Nomenclature. The author follows Crothers et al (2000) in recognizing all subspecies of *Crotalus viridis*, whereas Douglas et al. (2002) have shown that *C. v. abyssus, cerberus, concolor, helleri, lutosus, nuntius, oreganus, and viridis* are distinct species.

Few typographic errors have been found, although on page 395 the reference McCraine et al. 2001 fails to cite the journal, while on page 417 Chicago has additional letters under Spiteri (1991), and the author cites Ferrarezzi (1993a, 1993b) on page 197 but neither of these citations are listed in the literature cited section.

Even though the literature search ended in 2000, this book is an awesome review of the systematics prior to that date. This book will certainly be a welcome addition to any herpetologist library even though the book is somewhat pricy for consisting of only text and not having illustrations. We would highly recommend this book and compliment the author for having taken the time to compile such a welcome addition.

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HEADLESS MALES MAKE GREAT LOVERS & OTHER UNUSUAL NATURAL HISTORIES, By Marty Crump. 2005. University of Chicago Press, 199 pp. ISBN 0-226-12199-2. Clothbound $25.00.

Not since reading Lorenz (1952), Tinbergen (1958,1960), Lorenz (1963) and Eibl-Eibesfeldt (1970) have we been so captivated by a book on animal ethology. The author has provided the reader with what we would consider the most interesting ethology book covering varied and highly enlightening aspects on animal behavior with special interest on amphibians and reptiles, which represents the strangest phenomena ever compiled into a single volume.

The title might seem somewhat misleading, but an ethologist knows that this reflects the behavior of a male praying mantis which is attracted by the smell of a female hidden in a lilac bush, and creeps up behind his potential mate. He leaps, and with luck he secures a perfect grip on her body, and copulates. If by chance he misses or is off on his grip, the female will most likely bite off his head. The female instinctively knows that a headless male makes a great lover, because the copulatory movements in mantids are controlled by masses of nerve tissues in the abdomen rather than the brain, and males mate more effectively, and repeatedly, when decapitated. The female black widow spider is another creature which frequently kills its partner unless the male can escape extremely fast. Does this give you an indication of how ruthless a woman can be?

Anyone interested in herpetology will truly relish reading the chapters on the amazing parental behavior of such species as the Strawberry Poison Dart Frog (*Dendrobates pumilio*) that lay their eggs on damp leaves, and once the tadpoles hatch they wiggle onto their mothers' backs and the female carries the little black tadpoles to water caught between leaves of bromeliads to complete metamorphosis. This is not the only case which the author dwells on, but the Hellbender (*Cryptobranchus alleganiensis*) and the Waterdog or Mudpuppies (*Necturus* sp.) oxygenate their eggs and young, while the Oriental Giant Salamander (*Andrias japonicus*) guards its eggs up to 50 days.

Parental care is also know in the Reptilia in several species of pythons, the American alligator, and some species of fish, scorpions, wolf spiders, some giant water beetles, numerous species of birds, and mammals which all nurse their young. The excellent example of the Red Kangaroo (*Macropus rufus*) of Australia cares for its offspring for well over a year, and the female is capable of providing two different kinds of milk for her nursing babies. The offspring attached to the teat in the pouch receives low-fat milk, whereas the active teenager gets higher-fat milk.

Chapter three will prove extremely interesting and captivate your mind as the majority of people feel that all insects are nothing but disease spreading worthless creatures, but those thoughts will changed after having read the author's authoritative and highly interesting essay on dung beetles, which the author quotes "are worth their weight in gold-or at least in green feldspar and obsidian." These insects are doing mankind a great service in sanitizing the earth when they bury chunks of dung and use it for their favorite food. It is well know that Australia was faced with a problem in lacking dung beetles, and the introduction of cattle provided flies with a massive breeding ground which was detrimental for human health. This provided the incentive in 1993 for Australia to import foreign dung beetles from Africa. This proved to be one of the only successful animal introductions, as the majority have been nothing but failures. You'll immediately recall the Dracula movies of the 1970-1980's, and most people feel that all bats are vampires, but the majority are insectivorous, fructivorous, or flower eating, which feed mainly on pollen and nectar and occasional insects found within the flower. A few species are fish-eating, and the true vampires consists of only three small species within this group. The major concerns regarding these species are the possibility of human contraction of virus-caused diseases, such as rabies, or secondary infection of the wound.

The author provides the reader with extraordinary stories of curious creatures and their amazing behaviors. The author has a skill in storytelling and shares her enthusiasm for the unusual. Each chapter begins with the intriguing and then moves to the bizarre, ending with the most spectacular examples of animal lore.

It is hoped that her stories will inspire many to pursue studies of natural history and behavior.

This book has been made readily available to the layperson by its low cost, and anyone having purchased or read this book will certainly want to read it over and over again.

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THE AMPHIBIANS AND REPTILES OF EL SALVADOR, By Gunther Köhler, Milan Vesely and Eli Greenbaum, 2006. Krieger Publishing Company, viii + 238 pp. Illus, with 140 color plates, 132 maps. ISBN 1-57524-252-4, $49.50 Hardbound.

The senior author is well known for his productivity in producing such wonderful Herpetological books as Köhler (1996, 1999, 2000, 2001, 2003, 2005), Köhler and Heimes (2002), Köhler and Langerwerf (2000), with his emphases centered around the Central American herpetofauna.

The present volume opens with an introduction providing a short review of current published literature on this poorly known country. The authors summarize the morphological variation and distribution of all the known amphibians and reptiles of El Salvador in the collections of major museums in the United States, Europe, El Salvadoran and other Central American depositories. Taxonomic comments are provided for individual species when necessary.

The book is divided into six chapters, with chapter three giving an excellent overview of the physiography, climate and vegetation, along with excellent color maps showing the ecoregions of El Salvador and provinces. The various vegetational divisions are illustrated, although several photographs are poorly reproduced and extremely dark.

Chapter four provides a short breakdown of the 130 species currently recognized from El Salvador, with 32 amphibians and 98 reptile species representing 30 families and 88 genera being recognized, along with erroneous and questionable record information. This is followed with a listing of the present twenty-four species having type localities from El Salvador, along with information on the type localities and current nomenclature.

The fifth chapter provides excellent dichotomous keys for the identification of the orders, genera and species of Salvadoran amphibians including tadpoles, and reptiles in both English and Spanish. Each species description provides a short synonymy of references, current name , ecological distribution in El Salvador, and short description along with natural history notes and remarks on conservation status and a distributional map for each species. This is followed by a listing of localities from which the species has been collected. Of the known amphibian species, two caudata, *Bolitoglossa heiroreias,* and *B. salvinii* are critically endangered. The critically endangered anurans are represented by *Agalychnis moreletii*, *Plectrohyla psiloderma* and *P. sagorum*, while *Hypopachus barberi* is considered vulnerable. The colored figures of the anurans are overall of excellent quality, along with the line drawings of lateral views of heads and foot webbing. This is followed by illustrations of oral discs of certain tadpoles, and a key to larval anurans of El Salvador.

Chapter six covers the Reptilia, with two protected species of crocodilians, along with eight species of Testudines, of which four are sea turtles and highly protected, one species of Emydidae (*Trachemys venusta*), considered threatened, one species of Geoemydidae belonging to the genus *Rhinoclemmys* which is common, and two species of Kinosternidae of which *Staurotypus salvinii* is of threatened status. The Sauria consists of eight families and thirty species found in El Salvador. Of the Sauria, *Abronia montecristoi* is the only species considered critically endangered, while of the seven families and fifty-five species of snakes found in El Salvador only *Boa constrictor* is cited in CITES. Each species account is provided with a lateral view of the head and dorsal color pattern for select species, which aids in identification. As for the other orders, distributional maps and color illustrations are provided for the Reptilia, although a good number of the figures are in poor focus or dark.

The authors feel this book is still a welcome addition to the herpetological field, as it provides an update on the fauna of El Salvadorasince Mertens' (1952) monograph published in German.

Following the serpentes, the author provides an up-to-date review of the literature cited followed by an index.

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Mackay, J. Lindleyi, Krieger Publishing Company, Malabar, Florida, 138 pp. 2006 A FIELD GUIDE TO THE AMPHIBIANS AND REPTILES OF BALI. Available from Krieger Publishing Company, $39.50 Cloth bound, ISBN 1-57524-190-0.

The impressive cover with a beautiful picture of a Paradise Tree Snake (*Chrysopelea paradisi*) will certainly attract the attention of anyone interested in herpetology. The title might be confusing as many not familiar with Asian geography might be reluctant about purchasing same. Bali is a mountainous, fertile, volcanic island of about 2,300 sq. miles between Java and Lombok in the Indonesian archipelago.

The introduction gives a brief description of the island of Bali, along with a colored map plotting major localities cited throughout the book, along with remarks on the major European museums having published books relating to Bali and surrounding areas. These include the rare books "1915, 1917 *Reptiles of the Indo-Australian Archipelago*, by Nelly de Rooij and P.N. van Kampen's 1923, "*The Amphibia of the Indo-Australian Archipelago*. These have served as the major baseline for future research of the herpetofauna of Indonesian archipelago, whereas the majority of present day articles have been published in scientific journals, which makes this book a welcome addition for our understanding of a little explored area.

Chapters two and three provide a short introduction for using keys and an explanation for using the species accounts, while chapter four provides an excellent account of the climate and vegetation, along with information on the five natural divisions, and list of species most commonly found in each section.

Chapter five consists of an overview of the herpetofauna of Bali. The fauna consists of 14 species of frogs and 57 species of land reptiles plus several marine turtles and sea snakes. The majority of these species are part of the southeast Asian assemblage. The Montane Chorus frog (*Oreophryne monticola*) is the western-most species; the locality for this genus is on Bali and Lombok. No species are specifically endemic to Bali alone. Bali has far fewer numbers of Anuran species than do the nearby islands of Borneo and Sulawesi. The author attributed this to the lack of available fresh water on Bali. Only two species of turtles, Asian leaf turtle (*Cyclemys dentata*) and the Southeast Asian Softshell (*Amyda cartilaginea)* are found in the central mountain areas, and both are very rare species.

Chapter six concerns the sea turtle trade prior to 1999. Since this time it has been discontinued, because the following year a large sea turtle was captured and killed for meat, but the turtle was over 2 m and one of the religious leaders indicated that the animal "was the incarnation of Segera Kidul, God of the South Seas." It was given ceremonial cremation with hundreds of village people attending the service. Since that time pork and duck are the favored meats.

Chapter seven covers first aid for snakebite, with excellent comments on the venom of a spitting cobra sprayed in the eyes of some unlucky individual, along with viper bites and treatment, and comments on the venomous snakes of Bali.

Chapter eight provides keys to the amphibians of Bali, in both English and Balasa Indonesian, followed by a key to the tapoles and remarks on habitat, distribution, and habits. Each species account is provided with color photographs of each species covered in the text.

The author describes the call of the introduced *Rana catesbeiana* (Bull Frog) as "ooom" which differs from the call of native populations in the USA, which has been described as "jug'o'rum." Cound this not possibly be *Rana clamitans* the author was taking about, or just a different style of interpretation?

Chapter 9 provides a key and species accounts for the five species of sea turtles and two species of fresh water turtles *Cyclemys dentata* and *Amyda cartilaginea*, and the introduced *Trachemys scripta* and *Dogania subplana*. The species *Cuora amboinensis* is cited and figured in the appendix section on pages 109-110, but as yet has not been recorded from Bali, along with the species of Caecilian, *Icthyophis khotaoensis*, frogs, *Limnonectes macrodon, L. microdiscus, Occidozyga lima*, skink , *Emoia a. atrocastata* and the serpents, *Ichylindrophis opisthorhodus, C. ruffus, Fordonia leucobalia*, viper, *Daboia russelii* and sea snakes, *Acalyptophis peronii, Aipysurus eydouxii, Astrotia stokesii, Enhydrine schistosa, Hydrophis atriceps, H. caerulescens,H. cyanocinctus, H. gracilis, H. inormatus, H. melanosoma, H. ornatus, H. spiralis, Lapemsis curtus,Pelamis platurus, Thalassophina viperina, Thalassophis anomalus*, and single sea krait, *Laticauda laticaudata*.

While Mackay states this book will serve as field guide to the Amphibians and Reptiles of Bali, this is somewhat misleading , as the book is 8 Ω x 11 inches in size, and will not be carried into the field by the average person studying the herpetofauna of Bali. Some of the author's plates are of rather poor quality, but considering the field collecting circumstances, and problem of not having access to a good flash unit, this might explain the excessively dark colored prints, or possibly it is the fault of the printers.

The species accounts are followed by the appendix for species not yet recorded on Bali, and a glossary and list of references on the Bali herpetofauna and index.

Overall this book will certainly be a welcome addition to anyone interested in the herpetofauna of Asia, and especially to those planning a trip to Indonesia. The authors feel it is a badly needed contribution to our understanding of the herpetofauna of a long neglected area.

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News and Notes

Errata:

Volume 42, Number 1.

Harris, Herbert S., Jr.

2006. Serum Electrophoretic Patterns in a select group of Mexican Montane Rattlesnakes (*Crotalus*) 42(1):30-34.

On page 30, paragraph 4, line 4: "The hematacrit tubes....", Should read "After the blood clotted, the hematacrit tubes..."

Society Publication

Back issues of the Bulletin of the Maryland Herpetological Society, where available, may be obtained by writing the Executive Editor. A list of available issues will be sent upon request. Individual numbers in stock are $5.00 each, unless otherwise noted.

The Society also publishes a Newsletter on a somewhat irregular basis. These are distributed to the membership free of charge. Also published are Maryland Herpetofauna Leaflets and these are available at $.25/page.

Information for Authors

All correspondence should be addressed to the Executive Editor. Manuscripts being submitted for publication should be typewritten (double spaced) on good quality 8 1/2 by 11 inch paper with adequate margins. Submit original and first carbon, retaining the second carbon. If entered on a word processor, also submit diskette and note word processor and operating system used. Indicate where illustrations or photographs are to appear in text. Cite all literature used at end in alphabetical order by author.

Major papers are those over five pages (double spaced, elite type) and must include an abstract. The authors name should be centered under the title, and the address is to follow the Literature Cited. Minor papers are those papers with fewer than five pages. Author's name is to be placed at end of paper (see recent issue). For additional information see *Style Manual for Biological Journals* (1964), American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

Reprints are available at $.07 a page and should be ordered when manuscripts are submitted or when proofs are returned. Minimum order is 100 reprints. Either edited manuscript or proof will be returned to author for approval or correction. The author will be responsible for all corrections to proof, and must return proof preferably within seven days.

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THE NATURAL HISTORY SOCIETY OF MARYLAND, INC.

MDHS .... A FOUNDER MEMBER OF THE EASTERN SEABOARD HERPETOLOGICAL LEAGUE

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Membership Rates

Membership in the Maryland Herpetological Society is $25.00 per year and includes the Bulletin of the Maryland Herpetological Society. Foreign is $35.00 per year. Make all checks payable to the Natural History Society of Maryland, Inc.

Meetings

Meetings are held monthly and will be announced in the "Maryland Herpetological Society" newsletter and on the website, www.marylandnature.org.

Note on the Testicular Cycle of the Costa Rica Water Snake, *Hydromorphus concolor* (Serpentes: Colubridae)

The Costa Rica water snake, *Hydromorphus concolor* occurs in Atlantic lowlands and premontane slopes from Guatemala to western Panama and Pacific versant central and southwestern Costa Rica to central Panama; it is diurnal and semiaquatic (Savage, 2002. There are reports of egg clutch sizes and their seasonal distribution in Solórzano, 2004). The purpose of this note is to present the first information on the testicular cycle from a histological analysis of museum specimens.

Six *H. concolor* males (mean snout-vent length, SVL = 473 mm ± 101 SD, range = 353-583 mm) from Costa Rica were examined from the herpetology collection of the Natural History Museum of Los Angeles County, LACM, Los Angeles, California. Specimens were collected (by province): January 1974, Alajuela (LACM 150750); January 1983; Aajuela (150747); May 1985: Limón (150745); June 1985, Limón (150744); October 1984, Puntarenas (150753); December 1966; San José (150751). The left testis and a portion of the vas deferens were removed for histological examination. Tissues were embedded in paraffin and histological sections were cut at 5 μm. Sections were mounted on glass slides and were stained with Harris' hematoxylin followed by eosin counterstain. Slides were examined to determine the stage of the testicular cycle.

The testes of all males were undergoing spermiogenesis. The lumina of the seminiferous tubules were lined by spermatozoa or several rows of metamorphosing spermatids. Tubules of the vasa deferentia contained sperm. Even though samples were not available from all months, the presence of spermiogenic males from most of the year: January, May, June, October, December suggests a prolonged period of spermiogenesis in *H. concolor* and that males are capable of insemination throughout the year. According to Fitch (1982) there is year-round breeding in snakes from some aseasonal equatorial regions. Other snakes from Costa Rica were similarly undergoing spermiogenesis in all months examined: *Erythrolamprus bizona, Erythrolamprus mimus* (Goldberg, 2004b); *Drymobius margaritiferus* (Goldberg, 2003b); *Ninia maculata* (Goldberg, 2004a); *Dendrophidion vinitor* (Goldberg 2003a); *Micrurus nigrocinctus* (Goldberg, 2004c). This cycle of prolonged spermiogenesis differs from the testicular cycles exhibited by many snakes of the North Temperate Zone in which sperm formation occurs during autumn and testes are in regression or recrudescence in spring (see for example, Goldberg, 2000, 2004d). Subsequent histological examinations of testes from additional species of Costa Rican snakes are needed to ascertain the frequency of testicular cycles with a prolonged period of spermiogenesis.

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A Second Specimen and First Record for Chihuahua, Mexico, of *Tropidodipsas repleta* (Serpentes: Colubridae)

Hobart M. Smith and Julio A. Lemos-Espinal

Tropididipsas repleta was first described by Smith *et al.* (2005) from a specimen collected by JLE in central eastern Sonora. No other specimens have been reported of the genus from north of Sinaloa.

A second specimen (JLE 14680) was found, also by JLE, on 18 July 2006 at km 36 on the autotrail Temoris-Chínipas, mpio Guazapares, Chihuahua (27°19'30.1"N, 108°18'41.9"W) at 1563 m. The specimen is a subadult, probably female, with an estimated total length of ~325 mm, tail ~50 mm. It is a road-kill, completely flattened (no more that 3 mm in thickness at most), but complete from head to tail, and was totally dehydrated when recovered. The carcass is fortunately mostly flattened dorsoventrally. It appears that the mouth was opened in defense when the snake was crushed, because the lower jaw is skewed relative to the dorsal surface of the head. The body is stiff, more or less U-shaped. Some dried viscera protrude from the anus. The snake may have been preparing to moult, because some epidermal scales have been sloughed since death through dehydration.

Critical in identification of the snake is its unique, totally black coloration, above and below, and the presence, as best as can be discerned, of 21 white rings encircling the body and covering one scale length on dorsum, two scale lengths on venter. No nuchal ring is apparent, and the caudal rings cannot be detected.

The head is so distorted that the labial and ventral scales cannot be described. A pair of small internasals is evident, much smaller than the prefrontals. On one side an elongate loreal is clearly discernible, entering the orbit; there are no preoculars, two postoculars and one anterior temporal. The ventrals number approximately 257, the subcaudals about 54.

The locality of the second specimen is about 138 km from the Sonora locality.

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Fig. 1 Locality records for *Tropidodipsas repleta* (two northern dots), and the nearest record for *Tropidodipsas annulifera* (in Sinaloa).

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Agkistrodon b. bilineatus in Western Chihuahua

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Occurrence of the Pichicuate (*A. b. bilineatus*) in Chihuahua, at Ejido La Ciénega, municipality of Chínipas, Chihuahua (27°27'27.5"N, 108°34'51"W, 600 m), was recorded by Lemos-Espinal and Smith (2006) on the basis of an observed specimen that we were unable to obtain. Recent field work in that region resulted in the capture of the first two voucher specimens of this species from Chihuahua. One (JLE 14681) was collected by Martín Velducea Avendaño at an abandoned ranch, La Higuerita (27°24'54"N, 108°30'6"W, 520 m), 4 km NE Chínipas, between Cerro Aguaje de La Cruz and Cerro de los Vitachis. This site is near a seasonal stream, La Higuera, surrounded by a tropical deciduous forest with medium sized trees and numerous large boulders (> 1.5 m diameter) on the ground. Large flat areas extend north of the ranch, but steep mountains lie southward, reaching 900 m. The other (JLE14683) was collected, also by Martín Velducea Avendaño, at Arroyo La Justina (27°22'7.2"N, 108°31'38.3"W, 475 m), 3 km S Chínipas. This is a permanent stream that forms a small canyon surrounded by large trees up to 20 m tall. The stream is in an area of large boulders (>1.5 m in diameter), is narrow (width average 1.5 m), and has few beaches but numerous small falls 2-3 m high and large boulders (> 1.5 diameter) on the ground.

Although unconfirmed previously from Chihuahua, the taxon is very well known by residents of the vicinity of Chínipas. Local residents know sites where pichicuates have commonly been observed. Some localities have even been named in reference to the snake, like Cordón del Pichicuate at Cerro de Los Vitachis.

A concept of the range of the species in this area may be derived from the sites of observation of it by local inhabitants, including Martín Velducea Avendaño. We list them as follows: Agua Caliente (27°27'28"N, 108°31'41"W, 572 m); Agua Salada (27°22'54.1"N, 108°28'8.6"W, 526 m); Cerro de los Vitachis (27°24'30.6"N, 108°28'38"W); El Camuchín (27°18'56.4"N, 108°29'12"W, 400 m); Gorogachi (27°16'21.1"N, 108°32'16"W, 730 m); Gorojaki (27°25'35.8"N, 108°33'18"W, 450 m); Justina (27°22'7.2"N, 108°31'38.3"W, 475 m); La Ciénega (27°27'27.5"N, 108°34'51"W, 600 m); La Higuerita (27°24'54"N, 108°30'6"W, 520 m); Las Borregas (27°23'4.3"N, 108°32'21"W, 470 m); Salitrillo (27°16'5.2"N, 108°27'48"W, 400 m); Tepochique (27°29'35.5"N, 108°23'33.2"W, 600 m).

We can thus surmise that in southwestern Chihuahua *A. bilineatus* ranges at least over altitudes of 400-730 m, latitudes of 27°15'-27°29', and longitudes of 108°23'-108°37'.

Local residents have observed this species most frequently during the dry season near various streams of the Río Chínipas (of the Río El Fuerte drainage). However, in the rainy season it has also been observed in the foothills near bodies of water.

The nearest previous record is ~58 km southwestward, near Alamos and Guirocoba, Sonora (Bogert and Oliver, 1945). The Sonora and Chihuahua records are in turn widely isolated from other records of the subspecies from southern Sinaloa Campbell and Lamar (2004)(Fig. 1).

Fig. Locality records for *Agkistrodon b. bilineatus* at northern Mexico.

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Syrrhophus interorbitalis (Amphibia: Anura) in Chihuahua, Mexico

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The species of frog described by Langebartel and Shannon (1956) is at present known from only three localities in northern central Sinaloa. The type locality is a rocky stream bed 36 miles north of Mazatlán (center of city). Campbell and Simmons (1962) reported the species from 65 miles north of Mazatlán, and Hardy and McDiarmid (1969) from 7.1 miles (by road) south of Guamuchil. These localities are the northernmost from which the genus *Syrrhophus* as defined by Lynch (1968) is known on western slopes.

A single specimen of this species was discovered by JLE 2 August 2006 on the east slope of Cumbre del Caballo of the Sierra Chínipas, Chihuahua, 27°22'22.4 N, 108°34'31.9 W, at an altitude of 1127 m. It was found in midafternoon hopping on a very steep slope with many loose rocks, in a habitat of oak forest and agaves — a narrow zone between evergreen forests at higher elevations and tropical dry forests at lower elevations. This is now the northernmost locality known for the species and genus on Pacific slopes, as well as an addition to the known herpetofauna of Chihuahua, extending its range some 230 km northward from the nearest locality in Sinaloa (Fig. 1). Duellman (1958) correctly predicted that the species might occur as far north as southern Sonora

Fig. 1. The locality of the present record for *Syrrhophus interorbitalis* in Chihuahua is indicated by a solid dot, and the nearest record, in Sinaloa, is similarly indicated.

The specimen at hand is JLE 14663, 30.3 mm SVL. It conforms with the characteristics of the *modestus* group of the genus, as summarized by Lynch (1970) and first recognized by Firschein (1954). It is 2 mm greater in SVL than the holotype, previously the largest known specimen. The extended hind legs from anus at right angles to the body measure 41 mm, and the foreleg 19 mm. The tympanum is vertically oval, 0.8 mm in maximum width, and its posterodorsal border is concealed under skin. The eye opening is 1.7 mm in horizontal width, the orbit-nostril width 2 mm and the interorbital distance 3 mm.

The species-group name indicates an important distinctive character for the species, described with a well-defined whitish bar across the top of the head over the middle of the orbits. That bar is scarcely discernible in the present specimen, presumably because it was captured during the day, when the melanophores are likely to be minimally evident. Otherwise the specimen agrees with the descriptions and illustration of pattern in Langebartel and Shannon (1956), Duellman (1958) and Lynch (1970).

The structure of the hands and feet conforms for the most part with the description in Langebartel and Shannon (1956). A terminal groove is present on all digits, and the 3rd and 4th fingers have terminal, truncate and slightly notched expansions at least half again as wide as the narrower parts of the digits. Langebartel and Shannon (1956) described the terminal expansions as 2.5 as great in width as the narrower parts, but their figures show considerably less. Unfortunately the terminal pads shrink in as short a time as 2-3 minutes upon exposure free from fluid.

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Pattern in *Barisia ciliaris* (Reptilia: Lacertilia) in Northeastern Mexico

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The 45 specimens of *Barisia ciliaris* Smith described by Guillette and Smith (1982) ranged in snout-vent length (SVL) from 90.7-158.3 mm, and none possessed a dorsal pattern on the body. The authors had not seen any smaller specimens to determine presence or absence of a pattern at a younger age.

Five specimens (JAL 14528-32) collected of that species by JAL at 17.5 km E San Antonio de las Alazanas, Coahuila (25°13'19.7" N, 100°23'35.6" W, 2817 m), confirm that at that locality a dorsal pattern is present at young stages at least to a SVL of 91 mm. The series represents lengths of 51-91 mm SVL, and every specimen has a series of 13-16, narrow, pale brown dorsal cross bands on a light tan background. Each band covers mostly one scale length, but in parts as much as two scale lengths. Similar cross bands, 16-18 in number, are on the sides of the body, only partially coinciding with the dorsal bands, and tending to be a bit longer than the dorsal bands. The dorsolateral junction of the lateral and dorsal bands is well defined, between the 3rd and 4th scale rows on each side.

The distinctness of the cross bands varies but little within the 40 mm size range of these specimens. They are slightly dimmer in the larger specimens, in which some of the posterior scales in any given lateral band have a posterior white edge. These may remain as the dark markings are lost at greater SVLs.

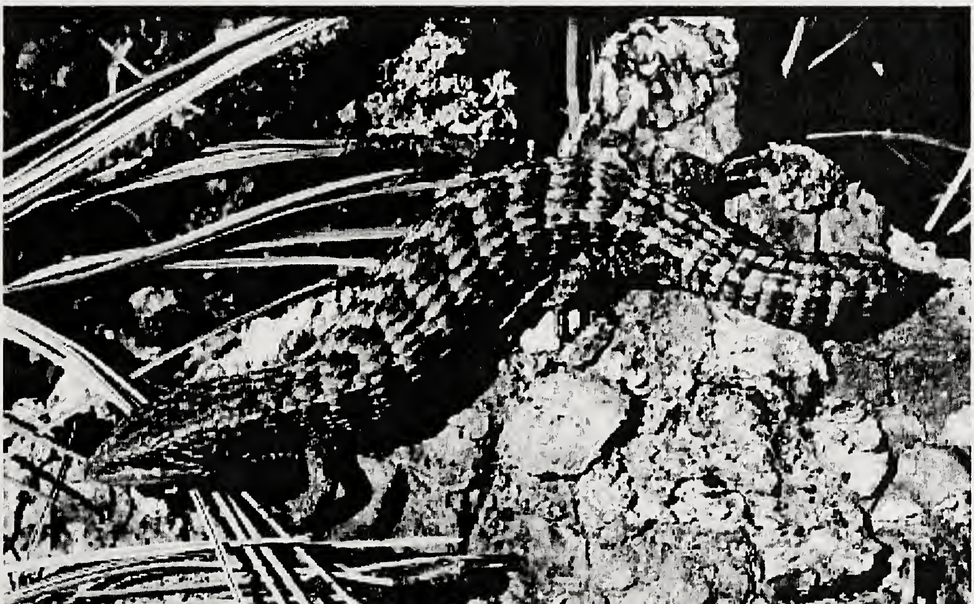

Fig. 1. *Barisia ciliaris* (female, JAL 14532), 17.6 km SE San Antonio de las Alazanas, Coahuila (courtesy Peter Heimes).

It therefore appears that loss of pattern in *B. ciliaris* usually occurs at SVLs somewhat greater than 90 mm.

Geographic variation in the species has not yet been thoroughly analyzed. The number of superciliaries in this series is constant at 4-4, whereas only 9% of the 90 counts reported by Guillette and Smith (1982) were 4. Even color and pattern can vary substantially, as indicated by the dark gray specimen from southeastern Chihuahua reported by Lemos-Espinal *et al.* (2000).

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Some Notes on Color Phases in Serpents

Many color phases known in serpents are reported in the literature. There appear to be at least three distinct forms known. A genetic malfunction resulting in the absence or abundance of a particular pigment or pigments, an ontogenetic form, and a genetic evolutionary adaptation that enhances species survival. This paper does not deal with aberrant color patterns as reported in rattlesnakes by Gloyd(1940), Klauber(1956) or Nickerson(1968).The following overview, is a synopsis of accumulated data as well as a review of some of the literature.

The black color phase known in many species such as *Crotalus h. horridus* (Gloyd, 1940), *Sistrurus c. catenatus*, and *Sistrurus ravus* (Gloyd, 1940; Klauber, 1956), *Heterodon p. platirhinos* (Conant, 1958), *Heterodon simus* (Beane, 2006) are well documented and usually are ontogenetic. Klauber (1956) mentions that *Crotalus v. ceberus* from the Santa Catalina Mountains near Tucson, Arizona, also approach this black or melanistic phase. Both Gloyd (1940) and Klauber (1956) have mentioned that some *C. nigrescens* also show this character.

Storeria. o. occiptomaculata generally occurs in two color morphs, a brown or tan color in the Coastal Plain and a darker grayish color in the Piedmont. The darker grayish specimens occur at higher elevations and melanistic specimens can occur in these populations. Melanistic specimens of *Storeria o. occipitomaculata* have been reported by Cooper (1959) and Harris (1975). These are usually large black individuals with black bellies.

The erythristic color phase in *Sistrurus miliarus miliarus* is known only from Hyde-Beaufort County area of North Carolina and is also well documented (Palmer,1971a, 1971b, 1992). There is a much greater abundance of red pigment in this population then in any of the other populations of *Sistrurus m. miliarius*. In Costa Rica, there occurs a xantic *Bothrops schlegeli* which is not that uncommon. These color phases are due to a genetic malfunction selecting the particular color pigment, which then becomes dominant, while surpressing all other pigments. Ocassional xanthic specimens have been reported, such as a *Crotalus d. terrificus* (Amaral,1932) and specimens of *C. v. viridis* from Kansas, South Dakota, and Colorado (Klauber, 1956).

In some popultions of rattlesnakes, such as *Crotalus triseriatus armstrongi*, there are several color morphs giving brownish , orangish or geenish colored specimens. This is probably an example of an evolutionary adaptation such as procrypsis.

The opposite also occurs, where there is a lack of one or more pigments, resulting in examples such as albinistic or leucistic specimens. These genetic abnormalities are rarer and do not afford procryptic adaptations and therefore you would not normally find populations.

Distinct color phases are known in at least two insular rattlesnake populations and in one montane rattlesnake population. These are more subtle hues and appear to probably aid in the species survival as procryptic coloration and in the insular species is ontogenetic, however, in the latter the exact mechanism is not clear. In the insular rattlesnake populations, *Crotalus catalinensis* and *Crotalus unicolor*, the two distinct phases include the normal light brown with some traces of blotches and a lighter plain bluish/gray phase. These phases correspond well with the rocky and beach habitat where these species are found. The lighter bluish/gray phase gives the snake a uniform appearance. As these species age they take on a very uniform pale solid coloration. Strimple (1987) gives a very detailed account of the coloration of *C. unicolor*. The other, *Crotalus transversus,* is a montane form, which has a brown (reddish or orangish) and a gray (brownish-gray, bluish-gray or grayish black)(Strimple, 1995, Lara-Gongora, 2004) phase. Again, the rocky habitat probably

aided in this evolutionary adaptation.

Some rattlesnakes are also known both in the field and in captivity (Klauber, 1956, Gloyd, 1940) to undergo some color changes, due to both substrate and/or temperature. Metachrosis is probably responsible for the distinct color variations known from different habitats. Procryptic coloration has been reported in several wide-ranging species. Klauber (1956) states "The southwestern speckled rattler (*C. m. pyrrhus*) is probably the most variable of all in color, for, in different areas, it is white, cream, tan, buff, drab, gray, brown, pink, orange or salmon." Background color matching is also well documented in *C. v. viridis, C. v. concolor, C.v. abyssus and C. v. nuntius.*

On El Muerto Island, *C. m. muertensis* matches its rocky background so well, it is hard to see as reported initially by Charles H. Lowe, Jr (Klauber, 1956). *C. m. pyrrhus* from the Tinajas Atlas Mountains of southern Yuma County, Arizona give us a basically white rattlesnake and in the Santa Ana Mountains of southern California the same species is a burnt orange. *C. m. molossus* from both the Santa Rita and Huachuca Mountains of southern Arizona stand out due to their beautiful coloration. *C. l. klauberi* in the Santa Rita and Huachuca Mountains have quite a beautiful splash of green, however, I have seen very large specimens from southern Zacatecas, Mexico which were all green with beautiful dark brown blotches with light tan centers.

Distinct color patterns in a single species is also well documented in *Lampropeltis g. californi*a as Stebbins (1966) states "...a striped phase with a more or less continuous pale yellow stripe occurs at scattered localities in sw. California." Conant (1975) lists three color patterns for *Lampropeltis m. alterna*, two for *Natrix f. compressicauda*, three for *Thamnophis s. sirtalis*, three for *Masticophis f. testaceus*, and two including a melanistic phase for *Masticophis f. flagellum*, three pattern variations for *Sonora episcopa* and two for *S. s. blanchardi*, and many others.

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Pseudemys and Trachemys, Indigenous and Feral, in Maryland

Both historically and recently, *Pseudemys c. concinna* and *Pseudemys f. floridana* have appeared in papers and books as a legitimate member of the Maryland herpetofauna. Several subspecies of *Trachemys scripta* have been introduced through the pet trade of the 1940's and 1950's and are thriving and reproducing in Maryland as well as elsewhere. One subspecies of *T. scripta* has also been found, but there is no evidence of breeding populations at this time.

Mansueti (1941) was first to mention the presence of introduced *Trachemys scripta troosti* in Maryland, and that there was evidence that it was becoming naturalized. McCauley (1945) mentions Mansueti's record and also a specimen he examined from Baltimore City, but clearly states that this species is not indigenous in Maryland. Cooper (1959) mentions that both *T. scripta elegans* and *T. scripta troosti* are feral and have been found in a number of areas in Maryland, and that the live material examined appears to be mainly *T. scripta elegans*. In preserved material, it is difficult to assign a specimen to either subspecies. Groves (1972) mentions numerous specimens of *T. s. elegans* collected in Frederick County, Maryland.

McCauley (1945) records both *Pseudemy floridana concinna* and *Pseudemys r. rubriventris* from Maryland. *Pseudemys c. concinna* is based on a report of a specimen from Plummers Island, District of Columbia (Brady, 1937). He also reports a specimen in the U. S. National Museum (USNM 45564), from Great Falls, Virginia. These same records appear to be repeated in Tobey (1985). Based on a specimen of *Pseudemys f. floridana* from 20 mi outside Baltimore (USNM 104439), Conant (1958), depicted the range of this species as Baltimore south, and did not include Maryland in the range of *Pseudemys c. concinna.* Reed (1956) includes *Pseudemys r. rubriventris, P. f. concinna,* and *T. s. scripta* as all occurring in Maryland. He incorrectly lumps all previous records (Brady, 1937; Mansueti, 1941;McCauley, 1945) of *T. scripta elagans* and *T. scripta troosti,* as pointed out by Cooper (1959), under *T. scripta scripta.* Reed (1956) bases the occurrence in Maryland of *T. scripta scripta* on a single specimen (USNM 137496) from Little Falls, North of Snake Island, Montgomery County collected April 2, 1956, which Cooper (1959) considered as introduced. Cooper (1961) gives a possible source of the specimen of *T. s. scripta* mentioned by Reed (1956).

Cooper (1960) in his Distributional Survey of Maryland and the District of Columbia lists *P. r. rubriventris, P. f. floridana* and both *T. s. elegans* (feral*) and T s. troosti* (feral) as occurring in Maryland. Cooper and Harris (1965) in the revised Distributional Survey: Maryland and the District of Columbia add *P. c. concinna* (Feral?) to the list, based on four juvenile specimens. Two are from near Elkridge Gravel Pits (RT 62 HSH/RSS-NHSM), one from the Patapsco River at its intersection with the Baltimore–Washington Parkway (RT 66 HSH/RSS-NHSM), and the fourth from an area off Fort Smallwood Road, all in Anne Arundel County.

Harris (1968) re-identified two Maryland *Pseudemys.* A fragment of shell identified as *P. f. floridana* (Nemuras, 1964) was re-identified as *P. r. rubriventris*. The *P. f. concinna* mentioned by McCauley (1945), USNM 45564, was also found to be a juvenile *P. r. rubriventris.*

Harris (1969) in a section "Doubtful or Erroneous Records and Possible Additions with a Comment on Siren lacertina" made the following statements:

"*Chrysemys floridana floridana* - Upon re-examination, all available Maryland material previously assigned to this species has been found to be *C. rubriventris.* Nearest reliable *floridana* records

are from the Rappahannock River, 5 mi. SE of Fredericksburg, Virginia, and the Dismal Swamp, Virginia."

"Chrysemys concinna concinna – Originally placed on the State list by Harris (Cooper, 1965) on the basis of two hatchlings collected in the Patapsco River at its intersection with the Baltimore-Washington Parkway. Since numerous attempts to locate additional specimens have been fruitless, it would be best to remove *concinna* until it can be proven to be native or established in Maryland. Nearest reliable records are from the Dismal Swamp, Virginia.

Harris (1975) in the same section of a yet a another revision of the survey makes the following comments:

"Chrysemys floridana floridana – Upon examination, all available Maryland material previously assigned to this species has been re-identified as *C. rubriventris.* A specimen of *C. f. floridana* collected "20 miles from Baltimore" is considered a release. Nearest reliable records apparently are from North Carolina. All Virginia records, except for an "established" colony at Richmond are questionable (Tobey, 1975)."

"Chrysemys concinna concinna – Originally placed on the state list by Harris (Cooper, 1965) on the basis of two hatchlings collected in the Patapsco River at its intersection with the Baltimore-Washington Parkway. Since numerous attempts to locate additional specimens have been fruitless, it would be best to remove *C. c. concinna* until it can be proven to be native or established in Maryland. Nearest reliable records are from the James River, near Wingina, Va. and from the head of Washington Ditch, off Lake Drummond, Va. (Tobey, 1975)."

These hatchlings were identified as *P. c. concinna* based on a "C" on the 2nd costal scute, a flattened lower jaw when viewed from head on, the fact that they did not have the sharp notch at the tip of upper jaw bordered on each side by a pronounced cusp as in *P. rubriventris* . At the time of collection, *P. c. concinna* was still on the State List, and we though we had finally "captured some specimens." Conant (1975), in his second edition does not show either *P. c. concinna* or *P. f. floridana* ranging into Maryland, following Harris 's recommendations.

Tobey (1985) on his map (p.73) for *P. c. concinna* in his Virginia's Amphibians and Reptiles, A Distributional Survey, for some unknown reason still shows the records for Virginia reported by McCauley (1945). Specifically, the record of Brady (1937) from Plummer's Island, D.C., and the Mt. Veron, Virginia record of Dunn (1920) for which there are no specimens. If specimens were available, these too, would probably prove to be *P. rubriventris*!

While driving roads in my study area in northern Anne Arundel County, my wife Iveta Stegmar, spotted a DOR turtle. Upon examination it was found to be *T. scripta scripta.* To my knowledge this is only the second reported specimen (Cooper, 1959). The turtle had an approximate carapace length of 13 cm. It was found just north of Tepper Road on New Cut Road, Anne Arundel Co., Maryland. It is preserved in the NHSM collection. A local pet shop claims to have purchased some, which they claim to still have, in a pond in the owner's daughter's Glen Burnie, Maryland back yard. They have failed to allow me to examine these turtles, and swear they have sold none.

In Northern Anne Arundel County, Maryland, there are many natural ponds and settling ponds, from construction of highways and homes. Based on the number of large adult *Pseudemys r. rubriventris* and *Trachemys scripta elegans* found crossing local roads and highways, I can say with certainty that there is gene flow between populations, even in the mass of concrete structures and chain link fences situated here.

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Translucent Skin/Scales in *Carphophis amoenus amoenus*

For the last twenty years driving a loop looking for snakes I observed something that seemed unusual concerning the beautiful pink venter of *Carphiopus amoenus amoenus*. I would find DOR specimens that appeared to have plain white venters…no pink. This seemed to occur in most specimens that were about a day or two old and really flattened by traffic.. If the specimen was a fresh DOR, the venter was pink. The mechanism responsible for this is not fully understood.

A specimen collected 10 September 2006, 0.4 mi. West Gambrills Road, on New Cut Road, Anne Arundel Co., Maryland (Excel Field Notes:1459) was completely flattened and folded over on itself. When held up towards the Sun, and using a hand lens, I noticed two things. One, the venter seemed to be transparent, and two, the dorsal surface/sides, seemed translucent. There was some separation between the ventral scales and the body tissue. This was a fairly fresh DOR, and the venter was a beautiful pink.

A another specimen DOR, but not totally flatened, collected at the junction of Burns Crossing Road and Clark Station Road/ WB&A Road, Anne Arundel Co., Maryland on 17 September 2006 (Excel Field Notes: 1483) had a beautiful pink venter. In this specimen there was no tissue separation and the ventrals and the sides/back of the specimen just appeared translucent when held up to the sun and examined with a hand lens.

A third specimen taken on 12 October 2006 (Excel Field Notes: 1627) was flattened and a section of ventrals were ripped open. In this specimen, the ventrals again seemed transparent, while the dorsal/sides seemed translucent.

Kelly, Davis and Robertson (1936) state "Held up to the sunlight, it is more or less translucent." McCauley (1945) states in describing *Carphophis* "Scales glistening opalescent; belly translucent, allowing the viscera to be seen through it." Wright and Wright (1957) mention in the description, under Genus *Carphophis,* the following- "Distinctive characteristics: Very small, cylindrical, solid, opalescent snakes, dark chestnut or mummy brown above; translucent belly, congo pink….", but do not explain this phenomon of a translucent belly any farther. It is obivious they used McCauley's (1945) information as he is cited later in the *Carphophis* account. In several other State works, Anderson (1965), Barbour (1971), Collins (1974), Minton (1972), Mount (1975), Smith, P. (1961) and Smith, H. (1950) I could find no mention of this character.

My observations indicate that the belly may be transparent due to the fact that the ventrals are unppigmented whereas the dorsum is pigmented and translucent.

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Partial Albinism in Maryland *Lampropeltis triangulum temporalis*

Harris (1967, 1968a, 1968b, and 1970) has published on abnormally pigment amphibians and reptiles in Maryland which included known examples of albinism. No examples, however, of albinism in *Lampropeltis triangulum temporalis* were reported.

A male and a female *Lampropeltis t. temportalis* collected about 5 mi. South of MD Route 4, off MD Route 760, Calvert Co., Maryland, was purchased by Robert Sparks, Jr shortly after they were collected in September 1987 (Figure 1). They were not collected together as a pair.

Figure 1. An adult male and female *L. t. temporalis collected in Calvert Co., Maryland.*

Since L. t. temporalis females produce eggs every year, plans were to breed this pair in the spring. These specimens were then kept in a cool basement, and kept covered to keep their environment dark, through out the winter. In the spring, they bred and the female produced five or six eggs, which hatched in July 1988. Among the hatchlings was one specimen lacking black pigment (melanophores)(Figure 2). The area, which would normally be black, appears colorless in life, almost translucent.

Figure 2. A hatchling *L. t. temporalis* lacking melanophores from parents collected in Calvert Co., Maryland.

It is interesting to note that a recessive gene for partial albinism exists in this wild population of Maryland *L. t. temporalis*.

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News and Notes

CHANNING, Alan and Kim. M. HOWELL, Cornell University Press, Ithaca, New York, 418 pp. 2006. AMPHIBIANS OF EAST AFRICA. Available for Cornell University Press, $45.00 Cloth bound, ISBN 0-8014-4374-1.

The authors Alan Channing is professor of Biodiversity and Conservation Biology, University of Western Cape, South Africa, and he also authored the 2001 book, *Amphibians of Central and Southern Africa* also published by Cornell University Press, while Kim M. Howell is professor of Zoology and Marine Biology at the University of Dar es Salaam, Tanzania, and had previously authored *Field Guide to Reptiles of East Africa.*

"East Africa is well known for its wealth of plants and animals, represented in game reserves, such as the Serengeti in Tanzania, the Maasai-Mara in Kenya, and Bwindi Impenetrable Forest Nature Reserve in Uganda. These reserves, and others like them, have been the localities of wildlife television documentaries that cover the well-known large mammal predators, the crocodiles, the herds of migrating buffalo, and of course, the gorillas. Less well known, but playing an important role in the east African ecosystems, are the amphibians."

The authors provide identification keys and detailed accounts for 194 frog species and 9 caecilians, with additional species being discovered yearly. The introduction is followed by a well deserved historical account of previous studies on the herpetofauna of East Africa, along with information on the major museums housing amphibian collections in East Africa.

The section on geography and environment provides short descriptions on topography, climate, vegetation, and forested regions, followed by an interesting chapter on conservation, with comments on the importance of amphibians in the ecosystem, threats to amphibians, and present day conservation efforts. A list of species cited by the World Conservation Union (IUCN) contains 52 species, which will certainly increase drastically in the future if those employed in the public and private agencies involved with conservation make special efforts toward the conservation of herpetofauna.

This is followed by a chapter on the classification, followed by comments on identification and introduction to the keys for 8 families of amphibians found in East Africa, representing the squeakers *(Arthrolepidae)*, toads *(Bufonidae)*, snout-borrowers *(Hemisotidae)*, treefrogs *(Hyperoliidae)*, rain frogs *(Microhylidae)*, clawed frogs *(Pipidae)*, common frogs *(Ranidae)*, and foam nest frogs *(Rhacophoridae)*. The caecilians are from the families *Caeciliidae* and *Scolecomorphidae*.

The species accounts cover the major portion of the book, and consist of 308 pages. They include comments on the known habitat preferences, distribution, advertisement call, breeding biology, and the characteristics of tadpoles of each species. Also provided is a section on notes and a guide to key references for further reading for each species.

The twelve species of Tanzanian *Nectophrynoides* are unique in having very limited distribution, and unique sexual behavior in being ovoviviparous in certain species.

The book is illustrated with 185 color images, 28 halftones, and 201 charts, graphs and maps, followed by an excellent section of tadpole identification, which is well illustrated, and finally a brief translation of those capable of reading Swahili.

A lengthy bibliography, systematic index and alphabetical index round out this badly needed volume.

This handsomely jacketed volume will certainly attract the attention of anyone seeing this book, along with its moderate price. We highly recommend it not only for the reference information, but for the color plates and broad array of interesting information. The authors and editors have done a wonderful job.

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News and Notes

KHAN, Muhammad Sharif, Kreiger Publishing Company, Malabar, Florida, 311 pp. 2006 AMPHIBIANS AND REPTILES OF PAKISTAN. Available from Kreiger Publishing Company, $145.00 Cloth bound, ISBN 0-89464-952-3.

The author has published extensively on the herpetofauna of Pakistan, and certainly is well known for his herpetological achievements in having published nearly 250 papers and four books on the fauna of Pakistan. He began his herpetological work by attending Punjab University in Lahore, receiving his bachelor's and master's degrees in the early 1960s. His doctorate was received from the same institution in 1996, and no doubt is the best trained herpetologist of his country.

This book represents nearly 40 years of research on the amphibians and reptiles of Pakistan, and includes an annotated checklist, keys to the species and subspecies and descriptions of all known species reported with color photographs of nearly all species represented. This is followed by a zoogeographical analysis, specific habitat use, altitudinal distribution, snakebite and conservation, followed by an extensive bibliography.

Each individual species account is provided with information on both common and scientific names, type locality, key characteristics, coloration, distribution, and natural history notes. Excellent comments on the present taxonomic status are provided where needed. Color photographs are provided for nearly all of the species covered in this book, although many of the figure are from preserved individuals.

Chapter eight provides an excellent zoogeographical sketch for the 223 presently known species. This represents an increase of some 79 species since Minton's (1966) record of 144 species of Pakistan.

In chapter nine, the author provides an excellent review of habitat types for this "land of many lands." A color map (figure 34) shows the major habitat types for twelve of the fifteen different zones found within Pakistan, followed by descriptions of each zone, along with a listing of major types vegetation and herpetofauna associated with each zone. This is followed by tables depicting the habitat types and species associated with each habitat.

Chapter ten discusses the altitudinal distribution of the herpetofauna of Pakistan, which are well illustrated on tables, while chapter eleven concerns the snakebite problem in Pakistan. The author estimates that about 1,000 deaths are reported yearly, mainly from the agricultural Punjab and Indus Delta areas. Comments are also directed towards the zoogeographic distribution of the terrestrial venomous snakes, and nonvenomous snakes frequently confused with venomous snakes in Pakistan.

The final chapter concerns the threat to the herpetofauna of Pakistan, which has drastically been altered by establishing Agni-orientated habitat, industrialization, the trade of reptiles for body parts used by native physicians, the pet trade, and supplying health institutions with extracted venom for antivenin production. The author recommended that all species of *Eurylepis, Novoeumeces, Mabuya, Scincella, Ophiomorus,* and *Tropicolotes persicus euphorbiacola, Enhydris pakistanica, Xenochrophis cerasogaster, Eristicophis macmahonii* and *Spalerosophis arenarius* be included in IUCN listing.

An excellent bibliography of an astonishing 443 references, for which more than 100 are from the author's pen, and an index round out this much needed volume covering a herpetofauna for which the major literature, previously published in a great many obscure publications, would otherwise have been overlooked.

The book truly is a welcome and useful contribution to the field of herpetology, and especially those interested in Pakistan, Afghanistan, India and China. The cost will probably prohibit many universities with tight budgets and individuals for purchasing same, although it certainly deserves consideration for anyone interested in the herpetofauna of this restless area.

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BELTZ, Ellin, Firefly Books, Buffalo, New York, 175 pp. 2005. FROGS: INSIDE THEIR REMARKABLE WORLD. Available from Firefly Book, Buffalo, NY, $34.95 Cloth bound, ISBN 1-55297-8969-9.

Anyone seeing the cover of this gorgeous book will certainly marvel at the figure of *Phyllomedusa tomopterna* (Tiger Striped Leaf Frog), and will immediately want to see what lurks inside the cover. The book is beautifully formatted, and with more than 125 color photographs. When one marvels at the cover, and then looks inside this (8 1/2 x 11 in) tabletop book, he or she will immediately become captivated by the excellent quality and clarity of the photographic images. Each photograph is identified by English and scientific name and shows different aspects of behavior (such as breeding and feeding, etc.).

Chapters 1 and 2 provide a brief historical account from the days of Swedish biologist Carl von Linné (Carolus Linnaeus.), along with a geological time table, and early amphibian history presently classified in 31 recognized families of living frogs and toads. These taxa are constantly changing, as the field of taxonomy has always been in flux, and will probably continue. The frog families are filled with valuable information, yet not overly technical. This makes the book extremely useful with a flowing style for easy reading, and keep the reader captivated. One fact of which we were unaware was the unique aspect of South American paradox frog *(Pseudis pradoxa)* in which its tadpoles reach up to nine inches in length, whereas the adults are only one to two inches in length. This unique paradox contributes to the name of the family. Also included is interesting data on the worlds smallest frog, *Brachycephalus didactylus* (Brazilian gold frog) and *Elueutherodactylus iberia*. The latter species, *E. iberia,* was recently discovered in 1996 in Monte Iberia, Cuba. Both of these species are only 3/8 of an inch (9.5 mm) from snout to vent, making them the smallest known tetrapod.

The discovery of a new family *(Nasikobatrachidae)* of frogs from Western Ghats of India in 2003 was truly surprising, and the Kerala purple frog, *N. sahyadrensis,* is primarily subterranean, and surfaces only about two weeks per year for mating.

The unique behavior and reproduction of the different genera and species will certainly prove to be of interest to the casual reader.

Chapter 3 is an excellent review on basic anatomy and physiology, with comments on ontogenetic development, reproduction, senses and communication, vocalization, and feeding behavior, along with other behavioral aspects associated with these. A brief but interesting review on skin and parotid glands is followed by an excellent discussion on the toxicity of various species, and recently discovered unusual mating strategy of some male European common frogs *(Rana temporaria)* which is called "nest piracy."

Chapter 4 is a review of environmental factors that affect frogs, and discusses the human-caused threats which have impacted populations throughout the world. Habitat destruction seems to be the major threat, along with chemical herbicides, pesticides, and industrial wastes, such as chemicals, metal and salt byproducts from mining and other industries. This information is followed by the more recent studies on chytrid fungus, global warming, introduced species and other diseases. In the past 15 years a considerable volume of scientific and popular literature on frog declines has been published, along with the newsletter FrogLog which highlights the most recent findings and present research.

Chapter 5 is an excellent review on popular stories, legends and the ways that various species have been figured in mythology from throughout the world. This is followed by a short chapter on "frog miscellany" which cites interesting facts about anurans.

The book is primarily written for the lay person, and certainly will be an excellent book for anyone having a budding interest in anuran biology, and herpetology in general. This book will certainly be a welcome addition for any professional herpetologist library for its concise, well written and illustrated summary of the order Anura.

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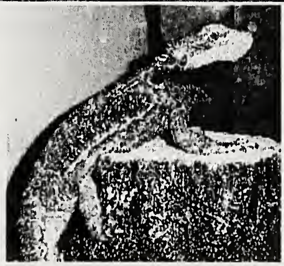

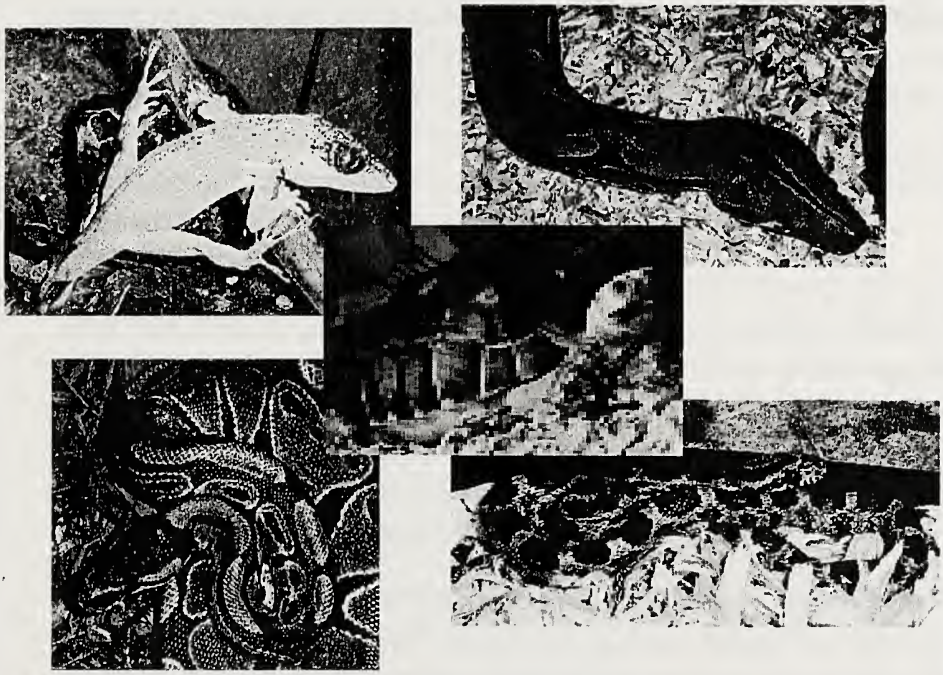

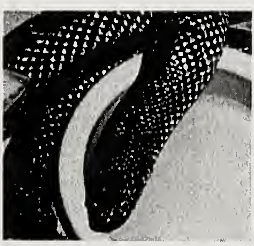

Society Publication

Back issues of the Bulletin of the Maryland Herpetological Society, where available, may be obtained by writing the Executive Editor. A list of available issues will be sent upon request. Individual numbers in stock are $5.00 each, unless otherwise noted.

The Society also publishes a Newsletter on a somewhat irregular basis. These are distributed to the membership free of charge. Also published are Maryland Herpetofauna Leaflets and these are available at $.25/page.

Information for Authors

All correspondence should be addressed to the Executive Editor. Manuscripts being submitted for publication should be typewritten (double spaced) on good quality 8 1/2 by 11 inch paper with adequate margins. Submit original and first carbon, retaining the second carbon. If entered on a word processor, also submit diskette and note word processor and operating system used. Indicate where illustrations or photographs are to appear in text. Cite all literature used at end in alphabetical order by author.

Major papers are those over five pages (double spaced, elite type) and must include an abstract. The authors name should be centered under the title, and the address is to follow the Literature Cited. Minor papers are those papers with fewer than five pages. Author's name is to be placed at end of paper (see recent issue). For additional information see *Style Manual for Biological Journals* (1964), American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

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Meetings are held monthly and will be announced in the "Maryland Herpetological Society" newsletter and on the website, www.marylandnature.org.

Notes on Reproduction of the Lozenge-marked Bicycle-dragon, *Ctenophorus scutulatus* and the Canegrass Two-line Dragon, *Diporiphora winneckei* (Squamata: Agamidae) from Western Australia

Stephen R. Goldberg

The lozenge-marked bicycle dragon, *Ctenophorus scutulatus* is known from the Exmouth Guld region, south-east through the Kalgoorlie region, Western Australia and north-western South Australia; the canegrass two-line dragon, *Diporiphora winneckei* is known from around the junction of the Queensland/New South Wales/South Australia borders through central Australia to the coast of Western Australia (Cogger, 2000). Information on clutch sizes of *C. scutulatus* are in Loveridge (1938), Pianka (1971, 1986) and Ehmann (1992) and for *D. winneckei* in Ehmann (1992). Additional information on proposed clutch frequency and seasonality of *C. scutulatus* reproduction is in Ehmann (1992). The purpose of these notes is to add information on the reproductive biology of *C. scutulatus* and *D. winneckei* from a histological examination of museum specimens collected by Eric R. Pianka in Western Australia. The first information on the testicular cycles is presented.

Forty-one *C. scutulatus* (19 females, mean snout-vent length, SVL = 81 mm ± 13 SD, range = 60-102 mm; 22 males, SVL = 84 mm ± 13 SD, range = 70-110 mm) collected between 26°28'S to 28°27'S and 119°05'E to 120°52'E during 1966-68 were examined from the herpetology collection of the Natural History Museum of Los Angeles County, LACM, Los Angeles County, California: LACM 54933-54937, 54939, 54941-54944, 54946, 54949-54952, 54954-54958, 54960-54964, 54967, 54969, 54974, 54975, 54980-54982, 54984, 54993, 54996, 54998, 54999, 55004, 55005, 55012, 55018. Data from these are in Pianka (1971, 1986). Twenty-one *D. winneckei* (5 females, SVL 54 mm ± 4.1 SD, range: 50-58 mm; 16 males, 45.8 mm SVL ± 5.3 SD, range: 35-58 mm) collected between 26°14'S to 28°08'S and 121°13'E to 123°55'E during 1967-68 were examined: LACM 55299, 55302-55305, 55308, 55310-55312, 55314, 55316, 55318, 55319, 55321-55324, 55327-55329, 55331.

Gonads were dehydrated in ethanol, embedded in paraffin, sectioned at 5 μm and stained with Harris' hematoxylin followed by eosin counterstain. Enlarged ovarian follicles (> 4 mm width) were counted. Male and female mean body sizes (SVL) were compared with an unpaired *t* test using Instat (vers. 3.0b, Graphpad Software, San Diego, CA).

The size (SVL) difference between *C. scutulatus* males and females was not significant (unpaired *t* test, $t = 0.82$, $df = 39$, $P = 0.42$). All testes examined were producing sperm (spermiogenesis). Lumina of the seminiferous tubules were lined by spermatozoa and rows of metamorphosing spermatids were present; epididymides contained sperm. Numbers of testes examined by month were: October (1): November (3): December (11): January (3): February (3). While the exact duration of the period of spermiogenesis was not determined due to a lack of samples from all months, it clearly includes the spring. Ehmann (1992) reported mating occurs in spring. The smallest reproductively active males (spermiogenesis in progress) measured 70 mm SVL (LACM 54950, 54981, 54999).

Pianka (1971, 1986) originally examined the females from herein and reported a mean clutch value of 6.8 ± 1.9 SD, range: 5-10 for those that were reproductively active. These females with enlarged follicles or oviductal eggs were collected from November to January. Thirteen ovaries examined besides the one reported on by Pianka (1971, 1986) were not reproductively active (no yolk deposition). By month they were: October (1); November (1); December (7); March (4). On

histological examination one female (LACM 54936) from 28 November contained corpora lutea from a recent egg clutch and was undergoing yolk deposition for a subsequent egg clutch indicating *C. scutulatus* females may produce more than one egg clutch in the same reproductive season. Ehmann (1992) reported gravid females with 4-10 eggs and thought it reasonable *C. scutulatus* females might produce more than one clutch. The smallest reproductively active female (enlarged ovarian follicles) in my study measured 88 mm SVL. It is likely that some smaller females also produce eggs but these were undetected because of my small sample sizes.

Stages in the testicular cycle of *D. winneckei* were: spermiogenesis (same as for *C. scutulatus*); early spermiogenesis (main period of sperm formation has yet to occur, small clusters of sperm line the seminiferous tubules); late recrudescence (just prior to start of spermiogenesis, metamorphosing spermatids are present). Sixteen testes were examined from *D. winneckei* males from the following months: August $n = 11$ (7 in spermiogenesis, 3 in late recrudescence, 1 in early spermiogenesis); September $n = 4$ (4 in spermiogenesis); November $n = 1$ (1 in spermiogenesis). The smallest reproductively active male (early spermiogenesis) measured 35 mm SVL (LACM 55322) and was from 21 August. All seminiferous tubules contained varying amounts of metamorphosing spermatids and about 25% contained small quantities of spermatozoa.

Females of *D. winneckei* were significantly larger than males (unpaired t-test, $t = 3.0$, $df = 19$, $P = 0.01$). Four females had inactive ovaries (no yolk deposition): September ($n = 2$); November (1); January (1). One female (LACM 55312) from 22 November contained corpora lutea from a previous clutch and yolk deposition for a subsequent clutch indicating *D. winneckei* females may produce more than one clutch in the same reproductive season. This lizard which measured 58 mm SVL was the smallest reproductively active female *D. winneckei*. It is conceivable that there are smaller reproductively active females, however my sample size was too small to include them. Ehmann (1992) reported *D. winneckei* females lay from two to seven eggs per clutch.

The timing of the testicular cycles in *C. scutulatus* and *D. winneckei* appeared similar to that of *Ctenophorus fordi* (= *Amphibolurus fordi*) as described by Cogger (1978) in which males commence sperm formation in September and continue at least into December. Reproduction occurs mainly in the spring-summer period in most agamids inhabiting temperate parts of Australia (Greer, 1989). Heatwole and Taylor (1987) summarized the types of reproductive cycles common in Australian reptiles. It appears the reproductive cycles of *C. scutulatus* and *D. winneckei* best match the Type I category of Heatwole and Taylor (1987) with spring spermatogenesis, mating and spring ovulation. This timing insures young will be born during summer and acquire sufficient fat reserves to survive during winter.

I thank Christine Thacker (LACM) for permission to examine lizards. Dustin Goto (Whittier College) prepared the histology slides.

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The Father of Delmarva Herpetology and The Pine Snake

Back in mid June 2006, I received word that Maryland's Department of Natural Resources (DNR), Natural Heritage Program had a proposal in place: "Title: An experimental reintroduction of the Northern Pine Snake (*Pituophis m.melanoleucus*) to the Eastern Shore of Maryland" (Smith, 2006). I immediately contacted the authors and the Department Heads at DNR and informed them that this plan would be an introduction, not a reintroduction! I appear to have been completely ignored. They were informed that all recent author's, Conant (1958), Conant (1975), Conant and Collins (1991), Conant and Collins (1998), Cooper (1960) Cooper (1965), CREARM (1973), Ernst and Barbour (1989), Ernst and Ernst (2003), Groves and Harris (1967), Harris (1969), Harris (1975), Linzey and Clifford (1981), Mitchell (1994) and White and White (2002) did not consider *Pituophis m. melanoleucus* native to Maryland or Delaware. As I understand it, additional meetings have taken place, without the involvement of the Herpetological Scientific Community and plans are apparently pushing forward with the "introduction" of a non-native species.

In recent correspondence concerning the fact that Pine Snakes, both historically and recently, probably never naturally occurred in Maryland or Delaware I was asked about Roger Conant's publications on the Delmarva! After all, Conant was the father of Delmarva herpetology. He collected the entire Delmarva at a time, when if Pine Snakes were indigenous, he surely would have collected them. But he did not!

I have four of his papers on the Delmarva and it is amazing that the Pine Snake is not even mentioned once! Conant (1945) in his checklist of the Delmarva, mentions having examined the Delmarva material preserved in scientific collections of the leading museums—except for Cornell University. He states that the material from Cornell is soon to be incorporated in a report on the reptiles of Maryland by Dr. Robert H. McCauley, Jr. The first sentence of the next paragraph states "No species are included in the following list unless specimens of them have actually been seen and studied". He states further "Other species have been "reported" from the Peninsula, but they are not corroborated by scientific evidence". He goes on to mention a few possible candidates, but the Pine Snake is not included. Interesting enough he did list the possibility of *Agkistrodon p. piscivorus*, but not *Pituophis m. melanoleucus*. Surely in his collaboration with McCauley and the above statement, he was well aware of McCauley's inclusion of the Pine Snake in his forthcoming work.

Conant (1946) wrote a very nice review of McCauley's (1945) Reptiles of Maryland, but again did not mention the Pine Snake. I am sure, that he felt that it was taken care of by his statements in his 1945 paper after mentioning his collaboration with McCauley and McCauley's forthcoming publication. McCauley (1945) mentioned the records reported by Kelly, et al. (1936) and does not accept the Centerville, Queen Anne's County record, but finds no reason to question the other reported by D. Truitt from ¾ mi from Snow Hill, nr. Pocomoke River, Worcester County and adds an additional verbal report of a specimen collected and released at Isle of Wight, nr. Bishopville, Worcester Co., Maryland. He does state"...the existing records from this state are not entirely satisfactory". These records are based solely on verbal accounts of specimens not seen by a qualified herpetologist and there are not specimens to back the records up.

Conant (1947) in his "Reptiles and Amphibians of Delaware" again fails to even mention the Pine Snake. He includes in this list, five species known only from Maryland but assumed to occur in Delaware. Again giving evidence that he is well aware of the overall distribution of amphibians and reptiles on the Delmarva Peninsula, from his own work, museum specimens and his collaboration with McCauley.

Conant (1958a) in his Notes on the herpetology of the Delmarva Peninsula, well after McCauley (1945), still fails to even mention the Pine Snake. A scientist such as Conant does not do this accidentally, as he was a firm believer that the Pine Snake did not and probably never occurred on the Delmarva!

Conant (1958b, 1975), and Conant and Collins (1991, 1998) do not mention Maryland or Delaware in the range of the Pine Snake or show them occurring in Maryland or Delaware on the distribution maps. What is indicated, however, and listed in the account and shown on the distribution maps is the disjunct distribution of *Pituophis* that we understand today.

In his most recent paper "The Delmarva Peninsula" Conant (1993) again does not even mention the Pine Snake. This paper discusses mainly his fieldwork in the 1930's, 1940's and 1950's and his marriage to his wife, which took place in his beloved Delmarva Peninsula. He does mention several species of amphibians and reptiles.

Conant knew pine snakes well from his many years in New Jersey, and a major theme running through all his important papers (particularly his Mexican papers on both the water and garter snakes) is an appreciation of, and fascination with, zoogeography. If he had considered the pine snake to be present on the Delmarva, he would have noted it and discussed it! It is safe to say that the father of Delmarva herpetology, Dr. Roger Conant, did not consider the Pine Snake, *Pituophis m. melanoleucus,* a native species of the Delmarva Peninsula.

Conant (1979, p. 474) in his paper on the amphibians and reptiles of Southern New Jersey, in a table, gives the overall range of the Pine Snake. He states under "Approximate Range in United States and Canada" the following "Southern: so New Jersey; SW Va., W. cent. Tenn. and cent. Ala; E to SE N.C.," specifically leaving out Maryland and Delaware. In his Reptiles and Amphibians of the Northeastern States, Conant (1957) was more specific in his comments: "Although it has been reported from the Delmarva Peninsula definite records are lacking." To my knowledge this is the first and only time he mentions Pine Snakes and the Delmarva Peninsula.

Any introduction of the Pine Snake would be an introduction of a non-native species. With the limited funding available to DNR, the possible loss already, of three of Maryland's Endangered Herptiles, surely the funds could be more wisely spent.

I would like to thank John D. Groves and David S. Lee who read and made valuable comments on the original manuscript.

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The Distribution in Maryland, both Recent and Historic, of the Timber Rattlesnake, *Crotalus horridus*

The distribution of the Timber Rattlesnake, *Crotalus h. horridus,* has been documented for Maryland by McCauley (1945), Cooper and Groves (1959), Cooper (1960, 1965) and Harris (1969, 1975). McCauley (1945) records it from Frederick, Washington, Allegany and Garrett Counties. These areas lie in the Appalachian Province, which include the minor provinces of the Allegheny Plateau, Valley and Ridge, Great Valley, and Blue Ridge. McCauley mentions old records (Warden, 1816, 1820) "…along the banks of Potomac, probably near Washington", which is in the Western Division of the Piedmont Province. He mentions that "It may also occur in the more rugged areas near the northern boundary of Maryland as far east as Harford or Cecil County", which are also in the Western Division of the Piedmont Province.

Cooper and Groves (1959) record it from NW Baltimore County, at and around the Pretty Boy Damn area. They also report on some old records, one in the summer 1952, from Overshot Run, which enters the north shore of the Loch Raven reservoir, not far from Sunnybrook, Baltimore, County. They mention that this specimen was brought to the Baltimore Zoo where it was identified and gave birth to several young. They report additional sight records from a quarry near Texas, Baltimore Co., and at "Rocks", Harford Co. The latter two records being sight records have not been accepted, although its past occurrence there is possible. The Timber Rattlesnake occurrence around the Pretty Boy Damn area is well documented. As Cooper and Groves (1959) point out, Pretty Boy and Loch Raven are both water supply reservoirs on the Gun Powder Falls. Occasional specimens could wander or be washed down the "river valley" during severe storms. One additional specimen was found in Timonium, Baltimore County when the shopping center was being built. Frank Groves (1969, pers. Comm.) who saw the specimen reported this record to me. Also of interest, is a statement given me by Dave Lee " During the winter of 1974, I responded to an ad of a couple selling their tropical fish tanks. When I picked up the tanks, I told the couple that I would be keeping snakes and turtles in them. They said when they had a large deck put on their house they had to blow away part of a rock ledge to set the base of the supports in concrete and it was winter and they blew open a den of hiberating rattlesnakes. Sounded like only a few, 6-12, but there was no way to follow up this story as I left for Florida in June 1974. The deck was added I believe in the winter 1973-1974. The site was just west and slightly north of Timonium between York Road and Falls Road but closer to Timonium."

Harris (1969) includes on his distribution map most of the records reported above. Harris (1975) adds additional records in the Appalachian Province and one additional record from the Western Division of the Piedmont Province at Sugar Loaf Mountain, in SW Frederick County (Figure 1.). He also reports on a specimen found in northern Anne Arundel County, just after a severe storm (Hurricane Agnes, 1972) and considers it probably washed down during the flooding, or represents a release. The current known distribution of the timber rattlesnake, *Crotalus horridus horridus*, in Maryland, is represented by two relic populations, one at the Pretty Boy Dam area and the other at Sugar Loaf Mountain and from the Blue Ridge west to the Alleghany Plateau.

This paper needed to be written after it was learned that the Maryland Department of Natural Resources, Natural Heritage Program, had a plan to "reintroduce" pine snakes on the lower Eastern Shore of Maryland and likened the extant status of the pine snake to that of the timber rattlesnake. Cooper and Groves (1959) also reported a specimen of the timber rattlesnake collected near the southern end of Kent Island, Queen Anne's County. I am not sure how DNR missed this

one, but I first dealt with it in 1965 in the reprinting and revision of Cooper's (1960) paper. I again dealt with it, as editor, in the reprinting of the Cooper and Groves (1959) paper in both 1969 and 1971 in the Bulletin of the Maryland Herpetological Society. My final comments were presented in Harris (1975) where I state that the specimen in question was actually collected in Pennsylvania. An individual who was suppose to be on a fishing trip in Southern Kent County, was actually up in Pennsylvania, and when he returned the rattlesnake was "definitely collected in Kent County." This is a prime example of how incorrect records can wind up in the literature.

In this case, there were those of us who would not give up, and kept on questioning the individual the snake was given to until the truth came out.

In an internal document Smith (2006) states "On the Delmarva, the northern pine snake probably suffered a similar fate as the timber rattlesnake (*Crotalus horridus*), which also survived here at least the 1920's in riverine swamps (Brown, 1987)". This is a popular article in National Geographic and Brown (1987) never even discusses Maryland distribution of the timber rattlesnake...where did this statement come from? In this paper, however, there is a map put together by National Geographic staff based on unpublished data of W. H. Martin who studies living populations of *C. horridus*. On this map, the former range is indicated to include the extreme lower Maryland and Virginia section of the Delmarva Peninsula. This is based on old and unsubstantiated accounts from Newspapers between 1894 and 1901 and local place names, such as "Rattlesnake Hill," "Rattlesnake Island," etc. (White and White. 2002). White and White (2002) list the timber rattlesnake as extirpated but close the account with "Therefore it is assumed that this species, if it indeed occurred, has been extirpated from the peninsula." There is no scientific evidence that the timber rattlesnake ever occurred on Maryland's lower Eastern Shore or the Delmarva Peninsula. Mitchell (1994) reviewed this evidence and reported additional accounts, and he also states " there is no evidence that *C. horridus* ever occurred on the Eastern Shore (but see "remarks")." Under remarks Mitchell mentions old accounts by an 88 year old Dr. Dowling, recalled from the past, which were given to A . B. Fuller who passed them on to Roger Conant (note dated 6 November 1948). He also mentioned a place name "Rattlesnake Island" on the Delmarva's Atlantic coast at the Maryland-Virginia state line. It might also be worthy to mention, that Dr. Roger Conant in all his Delmarva publications never mentioned *C. horridus* as he also never mentioned *P. melanoleucus* (see Harris, 2007), and now we know he was aware of all of these historical accounts. Incidentially, there are no Pleistocene fossil remains known, of *C. horidus* or *P. melanoleucus*, from the Delmarva Peninsula (Holman, 1995, 2000).

As with the pine snake there is a hiatus in its distribution. There is a gap in the distribution of *C. horridus* from extreme north central North Carolina across Virginia and all of Coastal Plain Maryland and the Delmarva Peninsula and parts of southeastern Pennsylvania and north, west and south New Jersey. Ashton, et al. (2007), also discuss the disjunct range of the pine snake, *Pituophis m. melanoleucus*, and its historical link to *horridus* by Smith (2006).

With the Wisconsin glacial maximum, pre-existing fauna were erased in the area of the Eastern United States covered by ice. As the ice retreated during the Climatic Optimum (warm moist period), postglacial faunal migrations occurred and many southern species reached their northern most distributions (Smith, 1957). Even at this time, there is no evidence to prove that. *Crotalus horridus* and/or *Pituophis melanoleucus* occupied the Delmarva Peninsula which had formed prior to these events, as the migrations were northward and it would have taken a southern reversal to reach the Delmarva. Then during the Xerothermic period grassland moved eastward within the Prairie Peninsula and invaded the Delmarva Peninsula. Even today, there are still thought to be relic species present from that time. Hence, *C. horridus* and/or *P. melanoleucus* have not existed on the Delmarva at least since the presence of the Prairie Peninsula. This is way before historical accounts!

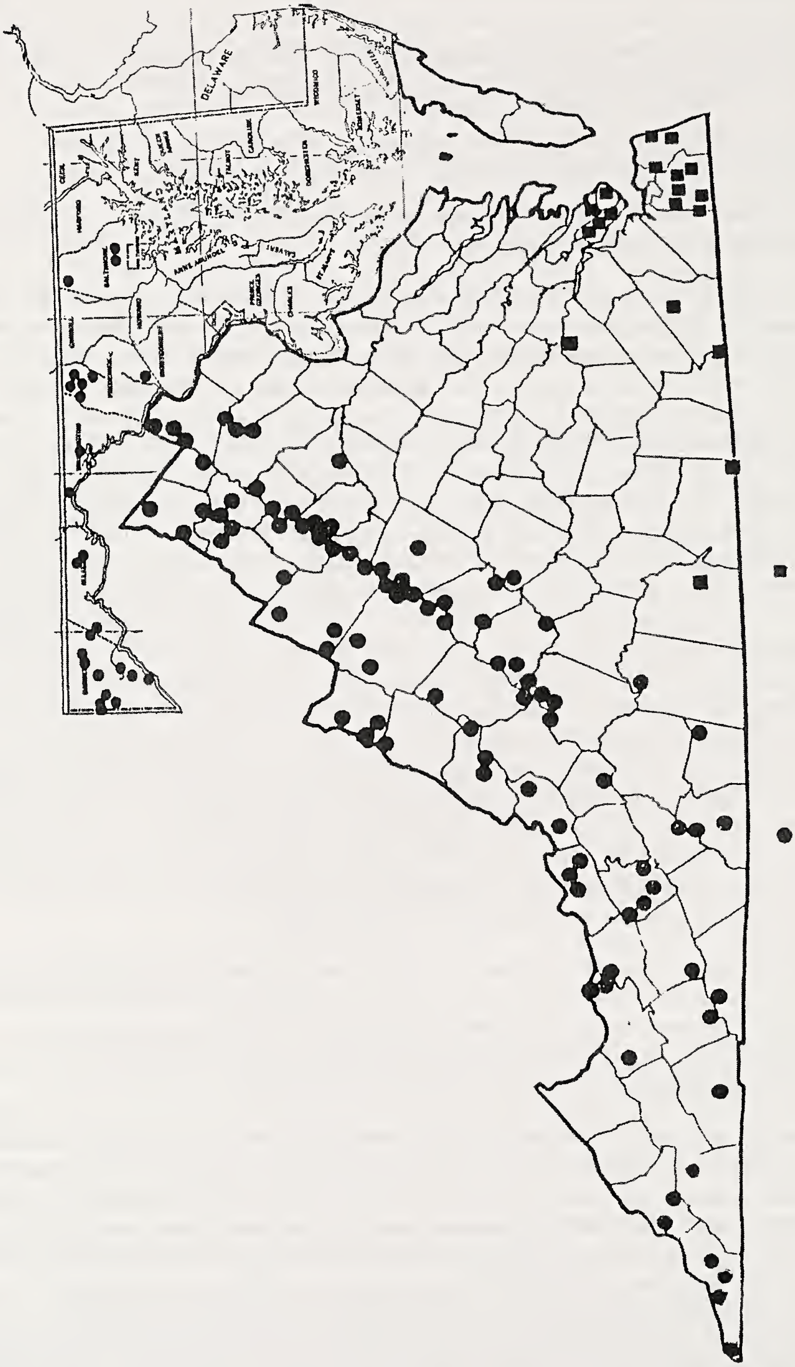

Fig. 1. Distribution of *Crotalus horridus* in Maryland and Virginia (Harris, 1975 and Tobey 1985). Circles represent *C. h. horridus*, and squares represent *C. h. atricaudatus*.

The only other remotely possible explanation of "timber" rattlesnakes on the lower Delmarva Peninsula would be from the northward penetration by the Canebrake rattlesnake, *C. h. atricaudatus*. The nearest known records are from the Virginia mainland opposite the southern most tip of the Virginia portion of the Delmarva Peninsula (Fig. 1.). Like with the cottonmouth, *Agkistrodon piscivorus*, however, there is no evidence whatsoever that this migration has ever occurred. With the current bridge/tunnel system connecting the Virginia mainland to the Virginia peninsula tip, many of us have expected to see an occasional *A. piscivorus* record turn up there. "Island hopping" by species is a well-known method of range expansion. *C. h. atricaudatus* is a Coastal Plain form in the southeastern U.S., while *C. h. horridus* is predominately a Piedmont and mountainous one. I suspect that the isolated New Jersey population is the result of the species working its way down from the north via Hudson or Delaware River valleys.

Back in the 1800's, with no field guides, and a fear of snakes, and the reputation of the "horrible" from colonial days was enough to think rattlesnakes were everywhere. They were to the north, they were to the south and they were to the west, and with no knowledge of species distributions and the natural occurring hiatus in the range of some species, who would have even guessed that they were not on the Delmarva? Anyone back then, and even now, encountering one of those tail vibrating black rat snakes would have thought they encountered a rattlesnake. We know that there is a black phase timber rattlesnake and I am willing to bet that the black rat snake (*Pantherophis obsoletus obsoletus*) accounted for many of the reports, especially where there were no specimens. Hence, "Rattlesnake Hill", etc. In my many years of collecting all over the Coastal Plain Province in Maryland, I have had many reports from people claiming that rattlesnakes were present in their area.

Unless additional evidence comes to light the historic range of the timber rattlesnake (*Crotalus h. horridus*) has been defined for approximately a half a century, and second guessing of old unverified reports serves no constructive purpose.

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The continued decline of rare and endangered state listed species: Tiger Salamanders in Maryland

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Ambystoma's February march: "Spring on the Delmarva starts early, and those who shiver quickly, believe in winter, or prefer to remain by the home fires till the late March thaw know of little except their yellow and purple crocuses. Spring first shows itself in the annual sex rites of the tiger salamander, rites so sacred they are witnessed by only a few persistent herpetologists."

With that as the introductory paragraph in 1975 I published a popular article about a decade of experience with one of the rarest animals of Maryland. I hoped that through my rambling account others would discover how damn interesting these salamanders are. For example, did you know there is a type of algae that grows only in the egg masses of these salamanders? The alga gets free lodging in their gelatinous, greenhouse- like, egg masses and for rent pays back the salamanders by producing oxygen for the developing embryos. How cleaver is that? Throughout the 1960s and early 70s I spent a lot of time trying to learn about tiger salamanders. By 1961 when I first saw them, there was a single known breeding population. It was scattered throughout a few isolated ponds in central Kent County. The account that follows is about a sad and inadequate attempt to preserve the species at its last remaining strong hold in the State.

Like other amphibians tiger salamanders have a two-part life history. The lung-breathing adults live on land, and are woodland creatures stalking prey in damp leaf litter and hiding by day in mole runs and under mossy stumps and logs. Between late December and mid February they migrate long distances on rainy winter nights to quiet ponds where they leave their egg masses. Their larval young are aquatic and restricted to the breeding ponds for about six to eight months. These ponds have specific ecological requirements for both the developing eggs and the fast growing gilled aquatic young.

The history of tiger salamanders in Maryland is brief. Soon after being discovered in the 50s most populations disappeared from habitat loss, and by the 60s the species was believed to be restricted to the one small area on the upper Delmarva. Over time the total remaining population in the State was for the most part dependent on a single man made pond near Massey in Kent County. Nearly everything we know about this species on a local level was learned from studies conducted in and around this single pond. Now it too is in trouble, serious trouble, and this interesting amphibian may soon no longer be part of our State's fauna.

One can surmise that these salamanders had a long zoogeographic history. Their historic distribution was probably set in the Pleistocene with the species working its way northward on the Atlantic coastal plain when sea levels were lower and prior to the formation of the Chesapeake and Delaware Bays (ca 15,000 years before government administrators). These amphibians must have lived on the Delmarva for minimally many thousands of years prior to the arrival of pre-Columbian man. Perhaps I should just feel honored that they even managed to persist here into my lifetime.

The larvae of tiger salamanders are veracious feeders; growing quickly they become the top predators of the breeding ponds. In a food study I conducted in the Massey pond I recovered 1,259 identifiable prey items from forty-two larvae. They were feeding primarily on swimming and bottom dwelling aquatic insects, and crustaceans. A few had eaten cricket frog tadpoles. They

were not specialized feeders, but it was clear that they needed a large and variable prey base. In the Massey pond the 3 ½ to 4 ¼ inch larvae each contained an average of 30 food items. The overall productivity of the pond was a key factor in their survival and growth. At that time these salamanders also bred in a smaller pond several miles away. The site was heavily vegetated and the surrounding forest shaded the water. Here the larvae, which like the others were only a few months old, were about 15 % smaller, were less abundant, had a less varied diet, ate smaller prey and were heavily parasitized by two species of nematodes which were absent in all the larvae of the larger pond. Because of the reduced oxygen in the pond, a result of decomposed leaf litter, the larvae in this smaller pond had noticeably larger gills.

Promises, promises: Despite this salamander's rarity in Maryland by the early 1970s the situation looked promising. Earth Day had become a tradition, people were becoming more aware of environmental issues. The State had established its own endangered species program. A group of us from the Natural History Society of Maryland, Inc. prepared a position paper on the rare and endangered reptiles and amphibians of the state. Of course the tiger salamander, because of it now being reduced to almost a single viable population, was high on the list. To our amazement the State adopted our 1973 recommendations and the species became protected by law. Because of the high importance of the single site to the species' survival in Maryland, The Nature Conservancy purchased the property in order to protect it. The 130+ acre site was later sold to the State for $292,785 in April of 1999. In 2003 a land management plan was approved for the site and the pond was designated as a non-tidal wetland of special State concern. In addition to the endangered tiger salamander the State endangered Lowland Loosestrife was also identified as growing adjacent to the pond. The condition of the Nature Conservancy's sale was the continued stewardship of the property for the tiger salamander population. The site is adjacent to the Millington Wildlife Management Area and it was to be managed and incorporated into it. This had the additional advantage of assuring there was onsite staff to over see the protection of the pond. The "prevailing goal for this site [was] the protection of the tiger salamander breeding pond and surrounding life zones." Plans for the enhancement of the property to expand the existing tiger salamander population through the restoration of another existing pond, and the creation of another one were on the table. Of all the species of reptiles and amphibians that we originally considered as endangered in the state, at last here was one that being protected, furthermore its population would be enhanced through land management. It was logical to believe that the other listed species would now also be receiving over due protection and, where needed, management. These are activities that state wildlife agencies have been successfully conducting for game species for decades.

Things were looking good.

Promises broken: Well, then almost nothing happened; at least nothing that helped the salamanders. The pond sat, trees from the surrounding forest were harvested by the State, while new trees were planted in a field adjacent to the pond (some darn government grant program that had noting to do with the salamanders). And over time the pond gradually silted in. What became of the salamanders? There was no evidence that anyone had been tracking the site. Maryland was in a cooperative program with the US Fish and Wildlife Service to monitor populations of native amphibians so the decline of the tiger salamander population must have been known by the State. The Maryland herpetologists who had kept notes on the tiger salamander's population for three decades were no longer allowed to visit the site as it was now 'protected'. The State would not share any information that it had subsequently obtained, and in a 1984 published symposium on the threatened and endangered plants and animals and animals of Maryland the species was not even mentioned. This symposium was published by the Maryland Department of Natural Resources. In the years that followed the conservation listing nothing was published on the tiger salamander

population by the State. Had new sites been discovered? Was the species still extant? With a three to four million a year budget for such matters and a number of staff biologists surely someone was assigned to look after this species. But as it turned out this was not the case.

Along comes Charlie: Now want to hear something scary? By the late 1990s I could not find anyone who had even seen a tiger salamander in Maryland during the previous five years. My friend Charlie Stine also became concerned. Charlie was one of two Maryland herpetologists who first discovered the species in Maryland in the 1950s. Through 1984 he continued to track the salamanders each year, counting egg masses and monitoring the pond's water chemistry and documenting the decline and eventual loss of the smaller, less healthy populations on the Delmarva. Originally he also reported these salamanders from the western side of the Bay in southern Maryland, but that breeding pond was destroyed when a golf course was constructed on the site. The other locality he found on the Delmarva also disappeared, so by the mid 60s many sites were lost and by the mid 80s the few Kent County sites were all that remained of what was obviously once a more locally wide spread species.

Concerned, Dr. Stine called the Department of Natural Resources only to be told that this was an endangered species and the information as to its occurrence was not available to the public. He pointed out that he knew the locations of the remaining sites, he just was inquiring as to the status of the population. This too was sensitive information. Well he had seen the pond and how it had changed over time but had decades of data on the population size in the past and he would like to compare that as to what it was now. The State was not interested in his "historic data" and if he were to work in the pond he would need to have a permit. Starting in 2002 several letters were sent to the people overseeing non-game species explaining the issues. Dr. Stine had documented a steady drop in the number of eggs deposited in the Massey pond since the early 1980s. The numbers fluctuated considerably because of weather conditions and the hydroperiod of the soils and of course the water levels of the pond. However by 2003 the total number of eggs was at an all time low, only 2.8% of the highest count in the early 1980s. Even after sharing this alarming information with the state he got no serious response. By this time Charlie was pissed, it would be interesting to know how many letters, phone calls, newspaper interviews, and follow up attempts he made to get to the bottom of what was really a simple alpha level issue. He made an appointment with the assistant director of Natural Resources and got a run around. After several years of this he finally was granted a permit, allowing him to actually get in the pond and see first hand what was taking place. (I heard later from several DNR staff members that the administration had actually alerted enforcement people about Dr. Stine and they would like for nothing better than to catch him illegally trespassing at the site. Was this the reason his permit request was so slow in being processed?) With permit finally in hand Dr. Stine called me and we picked a spring date when egg masses should still be visible. If they had already hatched we were prepared to seine for the larvae. We arranged to meet at the pond on a Saturday morning in mid March.

It was still winter for lesser creatures, snow geese were in the fields, and we saw a wintering golden eagle eating road kill along the Massey road. I had not seen the pond for several decades and drove past it twice before I realized it was THE pond. The woodlands had crept in from three sides and shrubs were everywhere along the shallow edges. The bottom of the pond was carpeted with grasses and sedges; this was a clear water pond with an open sandy bottom through the mid 70s. Charlie and one of his former students pulled up, looked and the pond and gestured, "See what I mean?" We pulled on our hip boots and proceeded to look for egg masses. With helpers four of us looked for several hours but did not find a single egg mass. Charlie was disgusted; the lack of egg masses and the successional state of the pond told him we were wasting our time. While the rest of us continued to look Charlie took a number of water quality tests. I suggested we seine a portion of the pond just to make sure we were not overlooking the salamanders. I actually

had the same seine I used in the early 70s to collect larvae for our food study. It was now hard to work, leaves, submerged sticks and branches tangled in our net. Yet it was refreshing to see Charlie, now 80 something, thigh deep in water pulling his end of a seine bogged down with water logged branches and leaf litter. (In earlier years the open nature of the pond made seining an efficient sampling technique.) Charlie and I caught very few aquatic insects, indicating that the former prey base was reduced, but more importantly we seined up a number of sunfish. Ahhhhh! Its rather well understood that most species of amphibians do not fair well in ponds that support fish. In fact, ponds with established fish populations are largely avoided by most breeding salamanders, frogs and toads. In the 70s I documented nine species of frogs and toads using this particular pond as a breeding site. Yet, we did not catch a single tadpole. Marbled salamanders that also used this site were absent too, even though this was a prime time to encounter their larva.

Charlie's water tests were informative, the pH showed acidity levels that are not favorable to the salamanders or their larvae. The increased pH apparently resulted from the decomposition of grasses and fallen leaves from the encroaching forest, and planted trees. Hey, and there we were, four of us, three cars, and milling about in clear view for the better part of a day, seining a protected pond and probing it with science tools. Did anyone check our permits to work in a protected and guarded conservation site? Permits that required two seasons to obtain. (I should add it was site directly across from the headquarters of the state's wildlife management area.) Hell no, it was a Saturday; everyone knows state employees don't work on weekends. If imaginary collectors of rare Maryland reptiles and amphibians actually existed I suspect they learned decades ago to go about their work on weekends.

After a follow up report about our visit, it was comical to see the spin the State put on its own neglect. While they admitted that they did not know there were predatory fish in the pond, they concluded this was natural, ignoring the fact that it was an introduced nonnative species, and that in decades of our monitoring the pond prior to the State's ownership bluegills were never encountered. They suggested to Dr. Stine that the larval fish rode in on the feathers of birds. Forget all the research on aquatic zoogeography of North American freshwater fishes; they apparently are entitled to frequent flyer miles. Obviously these people also were totally unaware of the nesting and parenting behavior of sunfish, their young would hardly be candidates for becoming entangled in avain feathers. (A more likely source is the DNR staff itself. On their web site they note that in the Millington Wildlife Management Area "that...farm ponds... are stocked with bass and bluegill for fishermen.") They dismissed removal of woody vegetation because the pond is also used by State endangered barking tree frogs. They clearly are also not familiar with breeding habits of this species, as it sings and mates while floating on the surface in the open portions of ponds and does not need emergent vegetation. In fact it avoids areas of ponds where vegetation abounds. I should note that they only used fish free ponds. "How do we know the barking treefrogs are here?" Charlie inquired, "are there any specimens or publications?" "No, but someone heard them here once," agency personnel responded. While all agreed the pond needed to be deepened for the salamanders it could not be done at this time because of staff concerns that the exotic ricefield bulrush would invade the site. It could "... exclude native vegetation that the salamander needed for egg deposition." I can see the female salamanders all armed with field guides to the native and exotic grasses and rushes trying to decide where to best deposit their eggs. Or maybe they would just deposit their egg masses on twigs the way they always have.

The exotic plant, of course, is a red herring. There are over 290 species of exotic invasive wetland plants identified as established in Maryland. Yet the State attempts restoration projects in other wetland habitats. Why are they not fretting about them?

Official letters responding to Charlie's concerns were demeaning. The first one he sent to the assistant director of DNR was answered with the very questions Dr. Stine proposed. Answers to Charlie's concerns were statements that had no merit. The only other document in writing was a follow up memo to an on site meeting Charlie forced on the agency. The summary of the meeting in the memo was simply yes we need to do something, but actually we can't because of a number of marginally related issues.

Dr Stine approached the host of a well-respected Baltimore-based talk radio show to address the problem and to bring it to public attention. As I was the only person other than Charlie to have studied and published information on the site prior to its demise I was asked to participate in the program. Together we exchanged our thoughts with the assistant director of DNR. During the hour-long show I found it hard to stay on track. In addition to call-in concerns of listeners about other endangered species issues the DNR keep switching the focus of the program to other topics and the State's overall new interest in saving ecological communities. It was clear that the agency was defending its turf and all specific questions were answered with fact-less generalities. Two points emerged in this program. First, it was clear that the agency did not wish to have outside input on their 'management' activities (this again surfaced the other week when the same spokesperson said in a newspaper interview that it was not the place of State representatives to tell DNR how to regulate the over fished diamond-back terrapin industry). Why they do not like others suggesting to them how to manage or regulate resources was not directly addressed, but it was implied that they are the only ones with the knowledge or data to do so. The second point was that the staff of the DNR had all the expertise they needed to make decisions. "If you get ten scientists in a room together you will have ten different opinions," is close to the exact quote we heard after I suggested an oversight committee for the State's sundry endangered species issues.

At the second meeting Charlie had at the pond (2006) many high level DNR representatives were present, once Charlie and the Nature Conservancy representative left, the person overseeing the State's endangered species program offered the offhanded remark, 'We really don't have the time or personnel to worry about any of this. " And everyone went back to their Annapolis offices. While I must admit I was surprised by the lack of interest in this salamander, I shouldn't have been. This is the same agency that after untold millions spent on research and monitoring has been unable to effectively manage and regulate the Chesapeake's multimillion-dollar crab and oyster industry in the world's largest estuarine system. It was unrealistic to think they would successfully oversee resources without price tags confined to a small man made pond. Charlie and I guessed right, in early June 2006 he revisited the pond, nothing appeared to have been done, there were no salamanders and the ecological desecration of the pond was at a new low.

What makes tiger salamanders so vulnerable? After the land was transferred to the State a deed of restriction clause stated "...that the management of the premises shall be limited to that which is in the best interest of the health and integrity of the rare, threatened, or endangered species or exemplary natural communities or ecosystems that may exist thereon...which shall continue ...with the running premises in perpetuity." The State considered illegal collecting of tiger salamanders, road salts and oils entering the pond, nutrient runoff, and waterfowl hunting in breeding ponds during the salamander's reproductive period all as potential problems. The managers sitting in offices in Annapolis drafting documents did not get it. As early 1976, Dr. John Cooper and I presented a paper on the problems associated with habitat protection for endangered species. John was the chairman of the State's original reptile and amphibian endangered species committee. At a meeting of The Southeastern Biologists we warned that land acquisition and laissez-faire policies alone were not always enough to perpetuate species in jeopardy, especially those listed at

state levels where populations may be peripheral. Active management programs may be needed for some species that had specific ecological needs and were now surviving only in relict populations. Maryland's tiger salamanders were listed as a case in point.

Maryland is not alone; most of the other states where eastern tiger salamanders occur also have the species listed as one of concern. Some are down to single populations but at least they are being looked after. Thus, this is not merely a salamander that is rare because it lives at the limits of its distribution, but one that is having conservation issues throughout most of its eastern range. The species is vulnerable on two fronts, as adults dwelling in woodlands, and as a species having very specific needs for its breeding ponds.

No one with experience with the salamanders monitored the breeding pond and over time the population declined. While the salamanders were protected from imaginary threats such as salamander collectors, the ecological conditions of the pond went unmonitored and once the site was owned and protected by the State it was not really possible for researchers such as Dr. Stine to continue their long-term field studies. There seemed no real need for it the State was charged with overseeing the land, the species and its management program.

So what went so wrong? It was the nature of ponds themselves. Historically, the species existed in a number of natural bay ponds, and later man made ponds in the area. As natural pond succession deteriated the ponds from the perspective of the salamanders (probably a result of our fire suppression policies), the populations reformed and temporarily prospered in new man made ones. As time went on the choices became fewer, the landscape was fragmented with new forms of land use, and the salamanders became restricted to marginal and inadequate breeding sites. The Massey pond silted in, and woody vegetation shaded the shallow edges of the pond. The decaying leaf litter shifted the pH of the water, and for reasons unclear the pond did not become dry during the late summer and fall. The woodland surrounding the area, the home of the adult salamanders during the non-breeding period, was logged. The State biologists told the State that their own logging operation, and the after math of 12-18 inch deep tire ruts and compacted soils would not be considered as "take" on the endangered forest- dwelling adult salamanders. This is an agency boasting that decisions are always made on the best available science, yet DNR receives about $3 million a year from selling timber from public lands. Well the scientific literature is full of information on tiger salamanders, their life history, habitat needs, and other information that would be useful for sound stewardship of the species. I looked but found nothing published concerning the cutting down of their woodland homes as a creative measure to enhance their existence. Does the agency have a conflict of interest here?

The net result was predictable, and could have been reversed if anyone in tune to the needs of the salamanders had been watching. Or even if anyone had taken the time to look into the warnings Dr Stine had been giving to the State for the last five years. The silted in pond became shallow, the decreased amount of water not only meant that the water temperatures available for the incubating eggs and the growing larva were less stable, but the larva were no longer able to move between cooler and warmer depths to thermal regulate their body temperatures. A warmer shallower pond meant that the water could hold lesser amounts of dissolved oxygen, while shading from the encroaching forest resulted in less direct light and lower primary productivity. The accumulating leaf litter made the water more acidic and studies elsewhere in the specie's range show that adult breeding males avoid acidic water. The acidic conditions increase embryo mortality, and a low pH influences hatching size and larvae growth. The increase in woody vegetation adjacent to the pond shaded the water further slowing the growth of both the salamander larvae and their prey base. The pond no longer supported the needs of the growing larvae. The death knell, however, was a result of the pond retaining water throughout the year. Several species of dragonflies with two and three-

year aquatic larval stages thrived in the pond and became significant predators of the newly hatched larvae. The sunfish we found in the ponds were at least 3 or four years of age. Whether they had been directly introduced into the pond or worked their way in during flood conditions is irrelevant. They were bluegills, a species of *Lepomis* that is not even native to the state. It is a fish that had been widely introduced by state wildlife resource agencies in the previous century. " We had no idea there were fish in the pond," one high-ranking State official told me. So was anyone overseeing this pond on a regular basis? Do we know why or, how long these predators were established here? Of course not, no one was allowed in the pond except State biologists. Pick your excuse for not being aware of the fish's presence--neglect, not caring, not understanding the issues. Legal responsibility for an endangered fauna should be accompanied with accountability.

Unscrambling the issues: All of this leaves two compelling questions. First, what can be done to help the Maryland population of tiger salamanders? Second, is this an isolated issue, or is it only part of a repeating pattern with other listed Maryland species, or by agencies in other states charged with the protection of "non-game" species?

It's hard to even tease myself into believing that anyone cares. People are no longer into nature. The average person is more likely to know the name of Paris Hilton's dog than to understand the most basic concepts of extinction. Our television channels are filled with programs on financial rewards for losing weight, becoming high finance apprentices, or making deals and no deals. And this is the world that our environmental protective agencies are forced to operate. The guys on the front line are caring dedicated people and their administrators are simply responding to the loud voices of developers, county land planners, and an uneducated public. However, in the case of this salamander, its protection was a done deal, the typical factors which jam up the best intended of conservation efforts were not present. This is neglect. It was a win where we could rally and show everyone how planned cooperative conservation can work. So what do we do? Whining and complaining are not acceptable. Well, at least as the final product.

This salamander, like many of our endangered plants and animals, has very specific needs. This is the reason that over time they become rare. Our changing land use practices tweak ecological factors, ones that to us may seem unimportant, and shift the odds for a species' long-range survival. In the case of the tiger salamander the proximity of breeding ponds to mature bottom woodlands is key, and over time agriculture and the timber industry, and the filling of wetlands took its toll. Roads bisecting the migration routes of breeding salamanders are a major problem, and as human populations increase so does our traffic. Here in Kent County we had an ideal situation, a rural setting and a pond in the proximity of forested wetland that had total protection from development. It's hard to understand that agencies with knowledgeable wetland biologists and forestry personnel on staff could not maintain the system. The issue is not the lack of expertise; it is one of neglect. That was true five years ago, but Dr. Stine continued to bring the issue to the forefront. Somewhere the problem shifted from neglect to arrogance.

The pond itself is the biggest issue. The decreased depth is due to siltation and the berm may have been breached by fish, or perhaps the berm is too high and the water can't escape. All of these factors can be easily fixed as the State has all sorts of major earth moving equipment. At a meeting held on site on 23 January 2006 with 10 or so high level State's employees, the Nature Conservancy and Dr. Stine it was concluded that the berm had been present for some time and that the pond would not be deepened. The breach is a naturally occurring event and that tiger salamanders "have adapted to the periodic presence of fish followed by fish absence." While this may be true, the situation at this point would suggest a jump-start of whatever remnants of the salamander population still existed was needed. I don't get this natural aspect. It's a man made pond. Back in

1957 when it was first dug as a borrow pit for road construction the adult salamanders started using the pond within 12-15 months as a breeding site. Scraping it down to ground zero would be a plus. If for some reason that cannot be done, make a new pond. This was one of their original management goals. The site is 130 acres and the State owns the adjacent lands as well.

Are there still additional breeding sites in Maryland? Back in the 60s and 70s we systematically searched the Delmarva, the few other ones we found were of poor quality, had small and declining populations, and the ponds supported stunted larvae with high parasite loads. In the 70s and 80s Charlie spent considerable flying over the Delmarva looking for additional ponds that might support tiger salamanders, but none were found. By 1984 a review of the status of the species in the State showed of the 19 total known sites twelve had been lost. Of the remaining seven all but one was in severe decline or was of marginal value when discovered. All but the population at Massey are now believed to be lost, this includes peripheral sites once known in the immediate area. Did State biologists with the 3-4 million dollar a year budget manage to locate additional viable populations? They won't share information, but I would like to think that after five years of badgering DNR about how serious this appears to be, that if they could that by now they would have at least told us not to worry, there are other significant populations elsewhere in the State. Except for the research of Charlie nothing new has been published on the species since the State assumed responsibility for protecting the salamander. The basic premise of science and field research, and that of sharing results of studies, has been ignored. When Dr. Stine asked to see the data they had on this species he was told it was privileged information. He tried to press the issue but the biologists he was speaking to told him he was rude and hung up the phone. I since had the opportunity to see some of the State's "field data". On 26 April 1999 a friend of mine accompanied the State's herpetologists to the one known breeding pond. They were there for less than two hours and no salamanders were found. In the past this was a time of year when thousands of larvae could be seen in the pond and samples could easily be collected for identification with a dip net. I suspected the State had no new information on the species and the last information made available to the public from the 50s through the 80s by Dr. Stine and myself was all that existed. Considering the fact that the species is likely to soon be extirpated from Maryland this may be the only information there ever will be. Well maybe some sympathetic soul will at the proper time write a meaningful obituary. The problem is it takes decades to document that something as secretive as a salamander is really gone for good.

So why is there a problem? One issue is a shortage of staff and unwillingness of the State's professional staff to recognize the knowledge and concerns of the public sector. Maryland has 400 species of conservation concern, more than most states, and far more than some countries. An unrealistic number of listed species makes it impossible to focus on specific issues. Unwillingness to seek outside expertise, or to take into consideration the well-intended input of knowledgeable people outside of State government is difficult to comprehend. This is especially true now, as the Wildlife and Heritage Service, the division that oversees these lesser creatures has seen a 97% decrease in money approved by the legislature between 2003 and this year.

OK, this part is good, pay attention. During the course of the last meeting Charlie had with DNR staff at the site it became clear to Dr. Stine that little if anything was actually going to be done. Charlie proposed that he would get some volunteers to at least remove the encroaching woody vegetation. The DNR person overseeing all this proceeded to tell Charlie that this would not work because DNR did not have the time to assign someone to supervise the volunteers. This is not a big pond, in fact, if everyone attending this onsite meeting had spend 20-30 minutes with some hand saws this aspect of the problem could have been taken care of. I was later told by staff in attendance that people could actually see the veins standing out on Charlie's neck. Yes he was mad, but how could he deal with the frustration?

During the last several decades there has been a decline of amateur interest in native reptiles and amphibians. Various wildlife laws prohibit collection and or trade in many species. The result is that people's interest has shifted from field studies to hobbyists who keep exotic pampered snakes and frogs that they purchase at reptile expos or over the internet. Their interest in native species has waned as they have no contact with species in nature or even knowledge of their natural history. While television nature shows promote the conservation of rain forests and Komodo dragons, or show children how to capture crocodiles with their bare hands, there is little information on local conservation issues. How many people knew there was a species of fish found nowhere else in the world except north-eastern Maryland? It was recognized as endangered by the US Fish and Wildlife Service and the State of Maryland, yet it became extinct in the early 1980s. Compare the lack of attention to this species with all the attention given to Tennessee's snail darter in this same time period. Again neglect won out. How can we expect our citizens to become advocates for local issues that they know nothing about?

And then there is nonsense. In a memo that went to the group of people assembled at the Kent County pond, Mr. Therres wrote " Massey Pond may have served as the major source population for the eastern tiger salamander in the Millington Wildlife Management Area. Its contribution as a source population seems to have diminished in recent years. However, a decline in the Massy Pond breeding population may not necessarily mean there has been a corresponding decline in the metapopulation." Well first, by the mid 60s this was the only viable population and it was the source population, possibly feeding several of the lesser breeding sites that eventually disappeared. None of the other sites were protected or managed and they died out. The Source/Sink concept of populations has been used to explain how some woodland birds maintain themselves in unstable habitats, namely they are subsidized by over-production in viable populations. Massey Pond was the source population, the sink populations overtime failed, and now the source population is itself in jeopardy. Therres ends the paragraph with "A more thorough analysis of this is needed." An analysis of what? The pond is now barely suitable for tiger salamander breeding, and the satellite breeding ponds in the area no longer support the species. Additionally DNR had already analyzed the situation; a year prior to this they published an in-house document that addressed the conservation concerns for tiger salamanders.

I thought that perhaps since they were the ones who originally acquired the site to protect the salamanders that The Nature Conservancy would be concerned. I contacted them almost a year now and explained the situation, but it has been three quarters of a year now and no one in their office has gotten back to me on any of this.

The bigger issue of course is what else is being lost through neglect? I think the answer might also be scary, very scary. A few years back I was invited to give a talk on reptiles and amphibian conservation to a sizeable group of people interested in Maryland herpetology. I started it off with a simple straightforward question. "Since 1972 when a number of native reptiles and amphibians were protected by the State, can anyone think of a single species that is better off today than it was in the early 1970s?" Not a single hand went up. Maybe if someone from the DNR had been present there could have been some positive answers, but we will never know. My talk, though well advertised, was on a Saturday.

For decades the answer of agencies has been "research." Somehow if we know more about these species they will all be better off. Science is good, and jumping in and helping animals with out knowledge is somehow dangerous. While this is a sound premise before wilily- nilly distribution of magic prescription drugs to someone with an ear infection, or before lift off on a manned space flight, it is not necessarily true when it comes to common sense wildlife management. I would like to think one would assume a forest dwelling salamander would not benefit from having adjacent

wood lots harvested. And likewise there has been a lot of research on many of the listed species. The needs of the aquatic larval stage of tiger salamanders is documented in numerous published studies done elsewhere, all of which would lead one to predict a crash of the population in a pond where changes in depth, water temperature and chemistry, the adjacent upland community, hydroperiod, and the presence of introduced predators all simultaneously occurred. In the specific case of this salamander Dr. Stine published 43 page paper on his decades of work with this species in Maryland. He clearly spelled out that is a salamander that requires early to mid successional ponds, and documented the decline of populations over time in nearby ponds that were maturing. In fact one of the ponds in his study was shown to be under the same successional decline in the 1970s that the Massy pond is experiencing now.

Maryland DNR did not need to study literature, Google information on the web or even read the paper that Charlie provided to DNR in 1984. They found the answers themselves. In a 2005 in house report on the state's biodiversity they discuss the tiger salamander. Under the topics of *habitat preferences*, *threats*, *conservation needs*, and *monitoring needs* this report spells out the exact same concerns presented by Dr. Stine and those that outlined here. Apparently DNR does not take the time to read their own reports, nor do they have the time to follow up on their own suggestions. Everything from successional change, to shifts in pH and fish stocking was clearly explained. This leads to the logical question why even spend four plus years preparing a multi volume report? This is not an isolated oversight. Conservation organizations monitor state programs in order to allocate maximum funding to agencies that will make the best use of the money. One noted that regarding conservation planning "MD should have paid more attention to previous work done even with their own DNR." The situation does not need study-- it needs fixing. And the fixing does not stop with the pond, it extends all the way to Annapolis.

It is not reasonable to expect agencies with no outside oversight to self-evaluate the success of their missions. Add to this other agencies and divisions have missions that are often conflicting. In the case of the tiger salamander there is a program to plant trees, and thousands of trees were planted adjacent to the breeding pond with no thought as to how this might impact the pond (shading, water temperature, transpiration of soil moisture, increased acidity levels from fallen leaves, or the use or avoidance of a forming woodlot based on tree species). Then there are game enhancement programs, native grass incentives, invasive species control, department of transportation needs, snow removal, ...the list is endless. In many cases the property is better off in private hands where the landowner can just say NO! In fact I have heard that on Long Island the single surviving tiger salamander breeding site known there was privately purchased and the site is successfully protected and managed for the salamanders.

The real issue is the fact that now because of endangered species funding professional biologists and their students are getting big bucks to research things that many of us did as hobbies in the past. State employees are being paid both salaries and expenses to do what was volunteered field activity less than 30 years ago. Much of the money of course comes from the feds, and federally endangered species receive most of the support, and thereby the attention of researchers. Not only is it hard to inspire the private sector to continue to work on these issues when other people are being paid to do this, but even well intended people can't help. Funding aside, the protected sites and species are off limits, the protection excludes volunteer assistance, as Charlie and I discovered permits are difficult to obtain, and the agency remains unresponsive to the small, and slowly decreasing, segment of a caring/concerned public. To some the answer would be to sue the State and force them to do the right thing. The problem with this approach is that funds to pay for the lost court action would come from money earmarked to help the State's endangered species while the 'environmental' lawyers winning the legal action would have funds to build even bigger trophy homes on some key wildlife habitat.

Solutions: The answers; education of local landowners, media exposure, and education in local school systems about our concerns of back-yard environmental issues. This is where conservation minded people become locally successful; it is much harder for us to have a meaningful impact on the destruction of rain forests in developing nations with high poverty levels. Someone needs to hold DNR responsible, they need to carry out their original management plan, and because of the fact that the survival of this salamander in Maryland is tenuous at best, the State needs to step forward, recognize the problems that have developed because of a decade or more of neglect, and place the situation into intensive care. And then there are letters, emails and phone calls to appropriate political representatives, hate to say this but these will be needed to change the direction of current policy. A likely solution for this specific issue is so simple. Make another pond modeled after the one scooped out in the 50s. The salamanders found that one and prospered in it for over three decades. Every two or three decades repeat the process. Be prepared for an agency's glossing over, stone walling response, and learn to read what they are actually saying. OK, the continued tiger salamanders presence in Maryland is not something that is a pivotal issue, but where do we draw the line? People have recognized that non-game, non-commercial species are important. Do not the woods seem a little wilder, does not the world seem a little less monotonous knowing that tiger salamanders are still with us—hiding under logs, and migrating to breeding sites on rainy winter nights? Our predecessors made clear that bison, elk, wolves, panthers, Atlantic grey whales, Maryland darters (and 30 other species of vertebrates) were not to ever again be part of Maryland's indigenous fauna. We have to live with that, but have not new ethical standards evolved? What will future residents of Maryland think of us, or our elective representatives and the commitment of our regulatory agencies as our native fauna continues to disappear? Perhaps more to the point, is what will we think of ourselves?

Since the pond no longer supports the needs of the growing larvae, the obvious question—will we one day need to have a memorial service for Maryland's tiger salamanders at their last known breeding site? Would it require a permit? Perhaps a memorial service for the State's endangered species program is more to the point. And how is it that pioneer naturalists like Dr. Charles Stine, well-intended and knowledgeable people willing to donate their time and expertise to state agencies charged with the responsibility to protect our natural heritage, are not immediately appreciated as an invaluable resource?

And now an update: Largely because of Charlie's persistence and as a reaction to an earlier version of this article that was published late in 2006 there have been several new developments. There is now a proposed State Wildlife Grants Project for tiger salamander habitat management at the Massey Pond. The proposal is for fiscal year 07 so at best the pond will not be improved for the salamanders until the 08 breeding season. Furthermore, the project is ranked 15th in priority so it most likely will actually never be funded. Tiger salamander management ranks below projects such as "data base management," "environmental review," "natural community classification," and "statewide assessment of dragonflies and damselflies." In fact of the 44 wildlife grants proposed for the coming grant cycle only five are actually for helping species at risk or for improving habitats. The remaining ones are for monitoring and data analysis. The proposal addresses removal of the adjacent woody vegetation, creating visual barriers of vegetation so the pond cannot be seen from the road, and chemical removal of one species of invasive plant. (The way I read the visual barrier idea, 2/3 of the previously open edges of the pond will continue to shade the pond and provide a constant source of additional organic material. I am not sure why they want to conceal the location of the pond for on their web site DNR lists Eastern tiger salamanders as "things to see" at this particular location.) A water control device will also be installed. Other issues, such as siltation of the pond, pH, and pond depth are not mentioned. Of the $18.000 budget, $12,000 is for contracted labor for woody plant removal. That's right, this is the same labor Charlie volunteered

for free nearly a year before. I asked a former student to calculate the actual cost for a commercial firm to scrape out the silt from the pond and to remove the vegetation in question and the total was less than $12,000. As for the rest of the budget; $3,000 is for DNR salary and overhead (I would assume the salary is for already existing positions), and $3,000 is for materials and supplies (saws and matches?). I suspect that the proposal is simply a back door for the agency, the wildlife people can now honestly say they prepared a management plan, but unfortunately it was never funded. It is informative that despite his interest and concerns that Charlie was not ask to review this plan, in fact he was not even aware of it.

DNR staff visited the pond in early 2007 and reported to Charlie that they found 11 egg masses. So it is refreshing to learn that the salamanders are still with us. However, this number is pitifully low. Using information published by Stine in 1984 13 egg masses does not necessarily document a viable population. The average number of eggs per mass is 52. So eleven egg masses would indicate approximately 572 eggs. This is only 4% of and well below the high count of over 14,000 eggs in 1982. DNR held a meeting of their Wildlife Diversity Committee on 24 January 2007 to discuss the tiger salamander issue and to report that the species was indeed still extant. At that time they reported on egg count information they had from recent years, the total being 2 egg masses in March of 2006. Since 1996 eggs have been reported in the Massey pond on only three occasions, 8-16 masses in 2003 (Stine, pers comm.), 2 in 2006, and 11 in 2007. In Stine's 1984 study he reports one female can produce up to 13 egg masses in a single season. He also notes an average of 350 eggs per female. Thus, egg mass counts in the teens would indicate only one or two adult females remaining in the population. If the number of eggs totaled 572 (this number is based on averages not an actual egg count for 2007) the female population would be 1.63, and based on Stine's calculations of 1.7 males per female the total population was 4.40 adults by 2007. Using these same methods for estimating the population size, based on egg mass counts Stine concluded that in 1982 the adult population was 216.6. This figure included a recruitment figure of one individual per breeding adult. Thus, using Stine's calculation method the current population estimate is 8.80 salamanders. This represents only 4% of the total estimated population from just two decades before and at this time we have no current information as to present day hatching success or survival rates of the larvae. Fluctuations in the number of egg masses per year is normal and is dependent on combinations of weather and hydrology, but there is no evidence of anything other than sharp declines since the mid 1990s.

To put this information into perspective, even when the pond was functioning in its prime there was a 4 to 12% mortality in the eggs and 3.6% transformation rate of the larvae. Information on the survival rate of transformation to adult breeding salamanders is unknown for Maryland. With the current estimated population size population models would predict that recovery, or even survival of tiger salamanders at this site is at best now unlikely.

The State did actually do some on site management of the pond between 2004 and 2006. This was apparently a response to Charlie's report of our visit there in March of 2004. They removed woody vegetation and stumps and treated the area with two different herbicide applications in October of 04 and 06. Charlie was very concerned about the use of chemicals in amphibian breeding ponds. I am not a biochemist but the growing literature on the negative effects of chemicals on native amphibian populations is alarming and concerns over the herbicides they used have been expressed. With a quick search on just one website I found 16 peer-reviewed papers on the effects of Glyphosat (the herbicide they used in 2004) on amphibians published between 1999 and 2005. Most were in the journal Environmental Toxicology and Chemistry. A general search of the web using the key words "herbicide, amphibians" yields pages and pages of titles of papers and published reports discussing the negative effects of these chemicals on amphibians (and their food sources).

Roundup, the brand name for one of the most widely used Glyphosat product, is a specific concern and even this product's manufacturer warns to not use this chemical in or near wetlands. Rodeo, the other commonly used Glyphosat based herbicide, had more favorable reviews but there were still a number of concerns regarding this treatment expressed on the internet.

It needs to be mentioned that Charlie visited the site twice after DNR's 2004-2006 restoration effort and thought that the vegetation encroachment was actually more pronounced than when we visited the pond in early 2004 and collected the introduced sunfish.

As a result of public exposure to the issue and a new administration in State government, Maryland DNR has now agreed to share information and consult with Dr. Stine on a regular basis and to include him in future management decisions for this site. Charlie, on the other hand, has by now concluded that state conservation appears to be based more on politics than science and questions if there is any value in trying to work with DNR. They reported at one meeting (Jan 07) that "a site or two" still exists, and on another occasion (March 07) they passed on through a third party that 3-4 sites Maryland were still viable.

Stay tuned, and lets hope adult tiger salamanders are longer lived than what is currently believed, and hopefully longer lived than Annapolis based foolishness. In the mean time DNR will continue to bask in their statement that "all their decisions are based on the best available science."

Footnote: This paper is updated from one published in December 2006 in the Bulletin of the Chicago Herpetological Society. As a result of that publication new information came to light and the state has **just now** started sharing some of it's information.

"It is horrifying that we have to fight our own government to save our environment."

-Ansel Adams

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Rodent Hygienic Behavior and Rattlesnake Predation

Abstract

Three strains of mice were shown to differ in hygienic behavior, with FVB mice being far messier and more odoriferous than either 129/SvEv or C57BL/6, which did not differ from each other. We then hypothesized that the FVB mice might constitute supernormal stimuli for rattlesnakes, and we tested this idea by observing snakes (5 Crotalus viridis, 1 C. horridus, and 1 C. unicolor) feeding on these mice and on 129/SvEv mice. No significant differences were seen in strike latencies nor in swallowing times; but contrary to our prediction, the predators took significantly longer to locate and begin to swallow FVB mice after striking them. We now speculate that the handling and smearing of feces causes FVB mice to be more confusing to macrosmatic predators than is the case for 129/SvEv mice.

Mammals differ dramatically in the physiological and behavioral processes that cause and control odors, including hygienic behaviors (Worden & Lane-Petter, 1959, and numerous authors in this edited work). Among rodents, differences are sometimes striking, as when house mice (Mus musculus) are compared with deer mice (Peromyscus of any species). Partly this is a function of the fact that the former tolerate crowding and are frequently kept in large numbers, whereas the latter do not tolerate similar crowding and are not successfully kept in dense concentrations. Even when low densities of the two types of mice are compared, however, M. musculus typically generates stronger odors than does Peromyscus (Dice, 1959 & Duvall & Chiszar, 1990). This point clearly agrees with Tuffery's (1959) recommendation that M. musculus cages be cleaned once or twice per week, while Dice (1959) noted that Peromyscus cages should be cleaned once per month.

Among the numerous strains of M. musculus, however, there is considerable variation in odor and in hygienic behavior, with some strains showing fastidiousness in fecal deposition away from sleeping areas, whereas others exhibit no such partitioning of their living space. Some strains commonly handle, ingest and smear fecal material around their cages, whereas other strains rarely exhibit these behaviors. Not surprisingly, fecal-handling mice are far more odoriferous than are those who do not engage in these behaviors. Our interest was in the response of rattlesnakes to mice varying in odoriferousness, and it was our initial hypothesis that mice with stronger odors might constitute supernormal stimuli and be preferred by rattlesnake predators over mice with weaker odors. This would, in turn, explain why fecal-handling mice are known only from captive strains, as they might be selected against in nature.

Because strain differences in odor, though long known in an informal way, have never been quantitatively documented, Experiment I had a naïve human observer rate 45 mouse cages containing an average of 3.9 mice per cage. All cages had been cleaned three days prior to this study (which was conducted to satisfy a course requirement in the Dept. of E E Biology). The student rated each cage for strength of odor (none, faint, medium, strong), amount of fecal material smeared on cage surfaces (light, medium, heavy), appearance of mice (ungroomed, average, well groomed) and appearance of nesting material (scattered, gathered into well-formed sleeping nest). One third of the cages were occupied by FVB mice, another third were 129/SvEv and the final third were C57BL/6. FVB mice are generally regarded by professionals (geneticists) as dirty mice, whereas 129/SvEv are very clean and C57BL/6 are normal or intermediate; but the student observer did not know these reputations and he did not know which strains were in which cages. Ratings were recorded in three sessions, at the rate of 15 cages per session, with cages presented by one of the authors (GA) who did not divulge the identity of the mice until after all cages were rated by the observer. All ratings were made in the Transgenic facility of the Department of Molecular, Cellular, and Developmental Biology, University of Colorado.

Table 1. Ratings of 15 cages of each of three strains of mice. All categories were rated on four dimensions (odoriferousness, fecal smearing on cage surfaces, appearance of nesting material, and appearance of the mice). Since the observer was unaware of the strains and since all cages were otherwise identical, we consider the ratings within each row to be independent.

	FVB			129SvEv			C57BL/6		
Odor	None or Faint	Medium	Strong	None or Faint	Medium	Strong	Faint	None or Medium	Strong
	5	6	4	14	0	1	14	1	0
Feces	Light	Medium	Heavy	Light	Medium	Heavy	Light	Medium	Heavy
	2	7	6	11	4	0	11	4	0
Nest	Scattered		Gathered	Scattered		Gathered	Scattered		Gathered
	11		4	0		15	4		11
Appear	ungroomed	average	well-groomed	ungroomed	average	well-groomed	ungroomed	average	well-groomed
	2	5	8	0	5	10	0	6	9

Data are shown in Table 1 where it can be seen that the three strains differed in odor (χ^2 =18.97, df = 4, P<0.01), smearing of fecal matter (χ^2=19.96, df 4, P<0.01) and in nest construction/maintenance (χ^2=18.60, df = 2, P<0.01). In each of these cases, FVB mice differed significantly from 129/SvEv and C57BL/6, but the latter two strains did not differ significantly from each other. Although more FVB mice appeared ungroomed than did mice of the other strains, this difference was not significant (χ^2=4.32, df = 4, P>0.05). If the cages were permitted to remain uncleaned for more than three days, all differences between FVB and the other strains would become larger, including the last one, as the FVB mice continue to come into contact with their feces. Accordingly, we conclude that FVB mice deserve their reputation for odoriferousness; but, we also conclude that 129/SvEv mice do not differ from C57BL/6 mice by any of our measures (when cages are three days past cleaning).

In Experiment II, we offered adult (18-22g) FVB and 129/SvEv mice to each of seven rattlesnakes (5 Crotalus viridis, 1 C. horridus, and 1 C. unicolor), all of which were well acclimated, long-term captives that had regularly been accepting M. musculus of various strains, including FVB and 129/SvEv. Strains 129/SvEv and C57BL/6 did not differ in Experiment I, nevertheless it was our subjective impression that the former were a bit cleaner than the latter, although this difference might not be detectible until cages were 7-10 days past cleaning. We used 129/SvEv mice in Experiment II to provide the strongest possible contrast with FVB mice. Snakes were maintained singly in glass cages (62x32x32 cm) at 26°C and with a 12:12 photoperiod (lights on 0700-1900). Each snake experienced at least two feedings with each type of mouse, freshly euthanized by cervical dislocation, and offered suspended by the tail from long forceps. In all cases, cages had been cleaned three-four days before mice were used in this study. After the snake struck, the carcass was dropped approximately 20 cm directly in front of the snake's head. We recorded the latencies to strike, to grasp the carcass and begin swallowing, and to complete swallowing. Since rattlesnakes typically strike and release adult mice, our second latency represents the time between the strike and locating the prey's carcass plus the additional time needed to grasp the prey's head. The third latency was the time between commencement of swallowing and the first post-prandial tongue flick. All prey were adult, 18-22g, and feeding sessions were weekly, with one mouse offered per week.

All snakes were offered at least two FVB and two 129/SvEv, and prey were presented in random order to each snake. All snakes struck and ingested mice on each session.

Table 2. Mean latencies and standard errors for seven rattlesnakes to strike, locate-and-grasp, and swallow mice of two strains. Snakes experienced multiple mice of each strain, and these scores were averaged to give one value per snake for each dependent variable and for each strain.

Strain		**Dependent-variable: Latency (sec)**		
		Strike	grasp head of prey	complete swallowing
129/SvEv	M	4.6	348.5	497.4
	SE	0.5	67.8	42.2
FVB	M	5.3	591.8	519.6
	SE	0.8	97.4	113.4
t-tests for paired comparisons		0.96	2.80*	0.58
*P<0.05				

Mean latencies are shown in Table 2 where it can be seen that our initial prediction was wrong. If the fecal-handling FVB mice were supernormal stimuli to the rattlesnakes, then we would expect latencies to be shorter for FVB than for 129/SvEv mice. In fact, all the numerical differences were in the opposite direction, although only the second latency measure exhibited a significant difference. So, instead of being supernormal stimuli, the FVB mice appeared to be relatively negative stimuli during the post-strike phase of predation.

General Discussion

Because predatory strikes at adult mice are primarily triggered by visual and thermal cues arising from prey, with chemical cues playing a subordinate role (Kardong, 1992; Kardong & Smith, 2002; but see Graves & Duvall, 1985), it is probably not surprising that we found no significant difference in strike latency for FVB and 129/SvEv mice. Furthermore, swallowing is a reflexively mediated activity that is influenced by prey shape and bulk (Cox et al., 1997; Cundall, 1987; Kardong, 1977). Since FVB and 129/SvEv mice were of the same size, the very similar swallowing latencies for these prey seem reasonable. Between the strike and commencement of swallowing, however, chemical cues are known to play important roles in locating the carcass and distinguishing the head from the tail (Chiszar et al., 1990; Duvall et al., 1980, Dullemeijer, 1961; Kardong & Smith, 2002). In this domain we initially expected the more odoriferous FVB mice to be located and grasped most quickly, but the opposite was true. Previous reports have shown that integumentary lipids, rather than urine or feces, are the critical stimuli for prey trailing by rattlesnakes (Chiszar et al., 1990; Duvall & Chiszar, 1990). Thus, we can hypothesize that the strong fecal-based odoriferousness of FVB mice might cover or obscure the chemical cues that are sought by rattlesnakes. Likewise, when snakes tongue flick the carcass after finding it, the anterior and posterior of a hygienic mouse will be clearly different to the snake's chemical senses (Duvall et al., 1980). But the FVB mice, having handled and smeared feces on their cages and themselves probably present a more confusing chemical "picture" to the snakes, causing them to rely on other cues for discriminating anterior from posterior (e.g., texture, shape, hair direction; Greene, 1976, 1997), and requiring more time to make the discrimination.

If these ideas are tenable, then we ought to be able to smear fecal material on the faces and flanks of normally hygienic mice, causing rattlesnakes to take more time to locate and grasp the heads of these carcasses. Likewise, we ought to be able to clean fecal material from FVB carcasses, thereby eliminating chemical confusion and reducing the trail following and grasping time of the rattlesnake predators. Another useful experiment would be to give rattlesnakes a choice between FVB and 129/SvEv carcasses presented side by side, as this test would reveal whether the lesser handling time for the 129/SvEv mice would translate into a preference for these over the potentially more confusing FVBs. Although the messy FVB mice appeared less desirable than 129/SvEv mice to our snakes, it is essential to keep in mind that predation in nature begins with snakes finding rodent burrows or colonies, and this behavior probably depends upon a diversity of cues, including those arising from excreta (Duvall et al., 1985). Therefore, we might expect FVB-like mice to be more readily discoverable than more hygienic mice by macrosmatic predators. While fecal-handling mice appear to be problematic for rattlesnakes in the post-strike phase of predation, they might well be especially easy to locate in the pre-strike phase (see Duvall et al., 1985, for a discussion of prey locating behavior in rattlesnakes; see Halpern, 1992, for a review of the chemical senses in reptiles). Accordingly, the mouse strains used in this study might prove useful in examining important aspects of pre- and post-strike behaviors in rattlesnakes as well as selective pressures acting on the maintenance of mammalian hygienic behavior.

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News and Notes

An article in the Baltimore Sun (Thompson 2007) points out funding and staffing issues currently facing DNR. There has been a considerable loss of positions and finding since 2002 and a structural imbalance in DNR's budget of $10 million. The Wildlife and Heritage Service, the division overseeing the proposed pine snake introduction, has seen a 97% decrease in money approved by the legislature from 2003 to this current year. They can't even apply for needed grants as they don't have the staff to oversee them. Is this the time to be considering the release of a problematic species into the state?

-Thompson, C, 2007. On the outdoors: The future is drifting away from DNR.

Baltimore Sun (Jan 28, 2007).

RE: What Price For Biodiversity?

Conservation and animal management history is full of disastrous attempts to introduce species into regions where they did not naturally occur. Witness the nutria and mongoose, the English sparrow and the starling, and worst of all, the gypsy moth, to name a few. Invasives like the rusty crayfish, alien earthworm, and zebra mussel have caused additional problems. Accidental/deliberate releases of "pets" such as snakehead fish, caimans, and red-eared sliders represent other "mistakes". And, what about the pythons in the Everglades?

Recently it has come to my attention that there is a proposed plan to release eastern pine snakes into the Pocomoke State Forest of Worcester Co. MD, when it is very doubtful if they ever naturally occurred on the Delmarva peninsula. Their range is disjunct with a large gap separating the populations in southern NJ from those in North Carolina. Historical records and field identification is questionable, and voucher specimens can no longer be located for their occurrence on the Eastern Shore.

I would like to express my thoughts about this proposal and invite other people interested in "herps" and their conservation to join me in this discussion. I have included details about a hearing scheduled early next month by the DNR of MD and would encourage those interested to attend. Also, I would urge people to submit their judgment on this project to the hearing board. You do not have to be a MD resident to be present or to respond; it would be great to hear from concerned individuals in DE and VA that share the peninsula.

I have it on good authority that PA has dropped the common eastern king snake from its list of native species deserving protection for want of accurate records that they ever occurred in the Commonwealth as a legitimate native species. Maybe MD should follow suit with the pine snake. I do not know where the pine snakes that are to be released will come from, but will they stay in place. Most reptile "transplants" turn out to be failures. Since these snakes are known to eat ground nesting birds and their eggs, what impact will this have on those avian populations? Will this move result in the loss (waste) of the pine snakes? Will an attempt be made to introduce the Pine Barrens tree frog onto the peninsula as a follow up (foul up)?

Would the state funds for this project be better applied to the tiger salamander or the diamond-back terrapin conservation and management programs in MD? I know that there have been staff reductions and budgetary cuts in the DNR of MD. Isn't the pine snake "re-introduction" a frivolous enterprise in view of these lost reserves? Why can't interested Marylanders visit NJ if they want to enjoy pine snakes? Isn't this a vainglorious attempt to claim and establish a species

for bragging rights without regard for the natural welfare of the snakes? I believe that it borders on a cruelty to animals charge if not an ecological crime. What say you?

I would appreciate it if someone would forward this to the MD-Birdline for their reaction. The invitation to the hearing follows below. Please scroll down for that information, and thank you,

Bill Kimmich

As a leader in the Maryland herp community, you are invited to attend the following public meeting. I am also asking you to disseminate this announcement to anyone you feel would be interested in DNR's proposed reintroduction project. We are seeking input from all interested parties:

DNR PUBLIC MEETING ON PROPOSED EXPERIMENTAL REINTRODUCTION OF NORTHERN PINESNAKES TO POCOMOKE STATE FOREST, WORCESTER COUNTY

The Maryland Department of Natural Resources (DNR) will hold a public meeting to discuss the proposed experimental reintroduction of northern pine snakes (Pituophis m. melanoleucus) to Pocomoke State Forest, Worcester County. The meeting, hosted by Towson University's Biology Department, will be held Saturday March 3rd at 1 PM in Smith Hall (Smith 326) on the Towson University campus.

Formal presentations will be followed by sessions to solicit public comment. Those unable to attend this meeting may send written comments to Glenn Therres, Associate Director, DNR Wildlife & Heritage Service, Tawes State Office Building E-1, Annapolis, MD 21401. Citizens may also call 410-260-8540 or toll-free in Maryland at 1-877-620-8DNR, ext. 8540. Comments may also be sent by fax to (410)-260-8596, or via e-mail to customerservice@dnr.state.md.us.

Public comments on the proposed project will be accepted until 4 PM, Friday March 16.

Speakers

Robert Zappalorti, Herpetological Associates, Inc.: *The ecology & natural history of the northern pine snake.*

Dr. William Grogan, Salisbury University: *Pine snake records for Maryland & Delaware: Is this a "native" snake?*

Dr. Richard Seigel, Towson University: *Relocations and reintroductions: Still an experiment or ready for use in the real world?*

Scott Smith, Maryland DNR: *Pine snake survey projects by DNR and partners: the path to reintroduction.*

Directions to Towson University

1) Follow the Baltimore-Washington Beltway north and east towards Towson till you reach the exit for York Rd, Rt. 45 South (Exit 27)

2) Take York Rd South about 0.5 mi., passing a McDonalds and then a Ford dealership on your right; just past the Ford dealership you will see a sign at a traffic light for "Rt. 45 South-Towson by-pass": make a Right on this light (the right hand lane is right turn only).

3) Follow the Rt. 45 South Towson by-pass about 1.0 miles till you go under a pedestrian walkway with the Burkshire Hotel on your left; you will then reach York Rd again (the by-pass goes around downtown Towson): make a Right onto York Rd South

4) The University will now be on your right; Follow York Rd. South 0.3-mi. past one traffic light till you see a large information sign for Towson University; there will be a small road going uphill just before the sign; make a Right onto this road (Glen Drive). (If you reach a second traffic light at "Bill Bateman's Restaurant" you have gone too far).

5) Smith Hall is at the end of Glen Drive, about 0.2 mi from York Rd. There is (limited) parking along the road and near Smith Hall. The bestbet for parking will be in the lot on your left as you make the turn from York Rd.

http://wwwnew.towson.edu/main/abouttu/visitor/dircampus.asp

News and Notes

BOOK REVIEW – RATTLESNAKE ADVENTURES: HUNTING WITH THE OLDTIMERS. By John W. Kemnitzer, Jr., 2006. ix + 224 pp. Krieger Publ. Co., Melbourne, Florida 32902-9542. ISBN-2-57524-278-8. Cloth $32.50.

Rattlesnake adventures consists of sixteen chapters taken from such outstanding naturalists as Raymond L. Ditmars, Edwin Way Teale, Carl Kauffeld, Richard Bartless, Samuel Scoville, Jr., Ted Levin , Edward B. Brown and the author. The majority of the chapters are taken directly from articles published in various books as cited in the bibliography, while the others have been supplied from various individuals concerned with the conservation of a species that has been nearly exterminated from eastern United States.

Kauffeld in "Snakes and Snake Hunting (1957) stated "that snakes are more numerous now than they ever were during pre-Columbian times." If that were the case, what has happened during the past 50 years?

Chapter one is taken from Raymond L. Ditmars book "The Making of a Scientist," (1937). Ditmars was instrumental in opening the eyes of the "average layperson when the average person thought the only good snake was a dead one."

Chapter two by Archibald Rutledge is from his book "Wild Life of the South (1935) reflecting his childhood in South Carolina when he observed an eight foot Eastern Diamond Back Rattlesnake (*Crotalus adamanteus*) near Witch Pond, while another was killed by a Negro turpentine worker several days later. This record has been disputed by herpetologists, although I can recall having received a shipment of snakes from Rattlesnake Florida while employed by the Kentucky Reptile Garden in 1951, during my school years which was of massive girth, although I had no intention of trying to measuring same.

Chapter three reflects Edwin Way Teale, and his wife's recollections with Eastern Diamond Backs (*C. adamanteus*) in their book "North with the Spring (1951), in which they cite an eight footer having been observed, although Ross Allen had offered an award of one hundred dollars for an eight footer, when rattlers only commanded a dollar a foot.

Chapter four reflects "The Sage of Sandy Hill," by Carl Kauffeld from his book "Snakes and Snake Hunting (1957) provides his numerous visits to Okeetee in South Carolina, where he was hunting *C. adamanteus* and canebrake rattlesnakes *C. horridus*, along with finding numerous other species of harmless snakes. The author states "of the two hundred and eighty snakes we brought back from Okeetee, sixty were Diamondbacks," whereas blacksnakes and kingsnakes were the most numerous species collected.

Chapter five by Frank Weed had spent almost 70 years in collecting snakes as a sideline in Florida and provides two short essays on his collecting of Eastern Diamondbacks.

Chapter six by Carl Kauffeld, and taken from chapter five in his book "Snakes: The Keeper and the Kept (1969) provides his escapades in capturing the Massasauga (*Sistrirus c. catenatus*) from Cicero Swamp in Onondaga, New York. This is followed by another article from Ditmars (1932) chapter seven in "Thrills of a Naturalist Quest" on a Timber Rattlesnake (*C. horridus*) and Copperhead (*Agkistrodon contortrix mokasen*) den in southern Massachusetts.

Chapter eight titled "The Saga of One-Eye," by Richard D. Bartlett, from his book "In Search of Reptiles and Amphibians (1988) describes a one-eyed *Crotalus horridus* being the last confirmed population of Timbers in the Connecticut River Valley of Massachusetts, whereas chapter nine by Samuel Scoville, Jr. "The Rattlesnake Den," is taken from his book "Wild Honey (1929),

describes his visit to Mount Misery Connecticut ten years prior to Kauffeld's visit, where he collected a large female which produced a litter of eleven neonates at the Philadelphia Zoological Gardens several days later.

Chapter ten is another chapter from "Snakes and Snake Hunting (1957) by Carl Kauffeld on his visit to the New Jersey Pine Barrens and Mount Misery some decade after Scoville's excursions, and which probably has in more recent years been destroyed by development and habitat loss, and not over collecting.

Chapter twelve is a relatively short essay by Raymond L. Ditmars, "Do Snakes Die in the Sun," and previously published in his book "Confessions of a Scientist (1934). This is followed by another chapter by Carl Kauffeld, "Denizens of Dutchess," from his book "Snakes and Snake Hunting (1957) where Kauffeld and Roger Conant. Roger collected forty-one Copperheads (*Agkistrodon contortrix*) from the den "Dutchess" located in Dutchess County, New York. The author and we cannot understand why anyone would collect such a large number of snakes from a single den, and what would anyone want forty-three specimens from a single site? After visiting the Dutchess locality the author moved on the Unity and Cat Rocks Den sites, where both Timber Rattlesnakes and Copperheads were known to occur. Every snake seen was collected whenever possible.

Chapter thirteen is a short essay by Edward B. Brown on the "{Birth of a Timber Rattlesnake Den Hunter," describes his rattlesnake escapades in finding dens in New York, while Ed has never collected or handled even one rattlesnake, he just enjoyed hunting for dens and observing same.

Chapter fourteen is an article by the editor titled "In the Footsteps of Ditmars and Kauffeld," refers to publications from the past that are extremely interesting in giving an insight into the persecution of this highly endangered species in eastern United States. DeKay (1842) refers to an article that reported "two men, in three days, killed eleven hundred and four rattlesnakes on the east side of Tongue mountain in the town of Bolton," and another reference by Surface (1906) who a Mr. Christian Wagaman, of Fayetteville, Franklin County, Pennsylvania found a den of rattlesnakes within five miles of Mont Alto, Franklin County and killed one hundred an forty individuals in a single day, and returned several day later and killed another one hundred and ten individuals.

The final two chapters by Ted Levin an accomplished wildlife biologist from his book "Blood Brook," titled "The Last Rattlesnakes," describes melanistic rattlesnakes, and the notorious snake collector Rudy Komarek from southern New Jersey, followed by a short chapter by the editor "A Night to Remember."

If these mass collectors would have only known that Eastern Diamondback Rattlesnakes probably only live in the wild approximately 10 years, and reproduce only at two to four year intervals and fail to reach maturity until about two to six years of age (Timmerman and Martin (2003), in-which the overall productivity of in individual female is extremely low, while the Timber Rattlesnake (*Crotalus* horridus) is nine years before a female is productive (Brown 1993), and then reproduce triennially with females only having as few as three to five reproductive events in her life time. I wonder this would have prevented the mass collecting for the enjoyment of collecting by Ditmars and Kauffeld although the majority were sold to Zoo's or the Institute of Butantan in Brazil, and used in the development of antivenom for the treatment of snakebite.

The senior author is honored in having all of the books cited in the literature cited, an being able to compare the rattlesnake adventures by the editor. This book will prove highly enlightening to anyone interested in rattlesnake or copperhead behavior and ecology.

The authors would highly recommend this book on the shelve of anyone interested in nature, and especially those interested in herpetology.

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News and Notes

BOOK REVIEW – AN OVERLOOKED BOOK RELATING TO THE HERPETOFAUNA OF ILLINOIS

The senior author was recently lucky in finding a book titled, An Essay Toward a Natural History of La Salle County, Illinois, in two parts: Part II-Geology and Zoology, by J.W. Huett. This book was published by Fair-Dealer Printing in Ottawa, Illinois, and probably was of very limited circulation. Philip W. Smith (1961, 1986) failed to site this reference, as had Willman and Payne (1942) and Wiggers (1997).

It is felt that this publication should be brought to the attention of anyone working on/or interested in the herpetofauna of Illinois, along with notes cited below on the unique taxonomic nomenclature used. The first generic name *Eutaemia* was used by the author for *E. sirtalis, faireyi* and *proxima* (Fitch 1980) *Bascaniom constrictor* (*=Coluber constrictor)* was used in Wilson (1978). These are apparently the first usages noted for these generic names, which undoubtedly were topographical errors by the author or publisher.

The author cites *Cistudo Carolina (=Terrapene carolina*) as not numerous, but the authors feel this was probably *Terrapene ornata* which is found in adjacent Whiteside and Lee counties, whereas *Terrapene carolina* has been recorded from several localities within the Chicago area (Phillips et al. 1999). *Chrysemys picta* was common with "sides marked with bright red," *Chelydra serpentina* was noted as common, and *Aspidonectes spinifer* (*=Apalone s. spinifera*) was common in the Illinois river and canal (Illinois-Michigan canal). The only saurian species listed is *Eumeces fasciatus* "on rocks near old fair grounds."

The serpentes were of greater diversity, with the spreading adder (*Heterodon platyrhinus*) found about the canyons, while the water snake, *Tropidonotus sipedon* (*=Nerodia sipedon, T. rhombifera (= N. rhombifera,* and Graham's crayfish snake, *Tropidonotus grahami* (*=Regina grahamii*) are cited, but without comments. It is interesting to note that *N. rhombifera* has been reported from the border of Woodford and Marshall counties, and possibly extended further northward. The author cites *Eutaemia sirtalis* (*= Thamnophis sirtalis)* and probably *E. faireyi* (*= Thamnophis proximus*) and *E. proxima* as being found within the county, and was reported from Lee county by Smith (1961, 1968) and Phillips et al. (1999).

The species *Bascaniom constrictor* (*=Coluber constrictor*), *Cyclophis vernalis* (*= (Liochlorophis vernalis), Coluber obsoletus* (*=Elaphe obsoleta*), *Ophibolus doliatus* var. *triangulus* (*=Lampropeltis triangulum*) and *Ophibolus calligaster* (*=Lampropeltis calligaster*) are cited as found within the county, but only the latter species cited as "being quite common."

The Banded or Yellow Rattlesnake *Crotalus horridus* and the Prairie rattlesnake or massassauga *Caudisona catenala* (*=Sistrurus catenatus*) are listed as "both becoming very scarce." The latter species had previously been cited for Cortland, DeKalb County (Wright 1941), and also plotted by Smith (1961) and Phillips et al.(1999) as pre-1880 localities. This species was also reported by several individuals familiar with this species from extreme southern DeKalb (Sandwich area) prior to construction of Edgebrook Country Club, and Sidney Allen, grounds keeper at Oak Ridge Cemetery and reliable friend of the senior author. This area bordering Somonauk Creek was ideal habitat for this species when examined by the senior author on numerous occasions, and northern LaSalle County was examined by David Sherman, an avid amateur herpetologist (pers. com.), prior to construction of Lake Holiday where considerable suitable habitat was still available.

The amphibian fauna is rather short with four species of anurans cited. The Leopard frog, *Rana viresens* (*=Lithobates pipiens)* and bullfrog (*L. catesbeana*) are cited. *Hyla versicolor* are cited

"as often heard, not so often seen. Their cry indicates a state of the atmosphere, not rain necessarily." The last species is the Warty toad, *Bufo lentiginosus* (=*Anaxyrus americanus*) which are "found about every garden, and it's the gardener's friend and assistant." It is noteworthy in citing the recent publication by Frost, Grant, Faivovich et al. (2006) in which the systematics of North American anurans has drastically been changed. Only two species of salamanders are cited, with *Ambystoma punctatum (=Ambystoma maculatum*) remarked as being this "handsome animal, from five to eight inches long, black above, with round yellow spots on each side of the back, and a slimy look; is sometimes found in cellars and other damp, cool places. It gives out a milky fluid from pores on its back," and the Mudpuppy, *Menobranchus macculatus* (=*Necturus maculosus*), which he calls the water dog, or dog fish is "found in still water with muddy bottoms, and known by its gills, which form tufts on each side of its head." It is very active and hard to catch, and should not be taken in the hand." For what reason the latter implies is not known. The specific name is also apparently in error, as we cannot find the use of a double *c* having been previously cited in the literature.

The author was very conservation minded and mentions under the water power section that man is "so capable in his unreasoning anxiety to get rich and to improve every inch of land around him, that he stops not to inquire what the result of his improvements will be, but rashly ventures to destroy the delicate balance" of nature.

The authors certainly feel this is of historical importance for anyone working on the herpetofauna of Illinois in the future, and also for its systematic usage of names.

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News and Notes

BOOK REVIEW – DIXON, James R. and John E. WERLER, University of Texas Press, 364 pp. 2005 TEXAS SNAKES: A FIELD GUIDE. Available from University Texas Press, Austin, $18.50 Cloth bound, ISBN 0-292-70675-8.

The authors have certainly served their primary purpose in preparing an excellent field guide geared for the amateur naturalist, although the identification keys, general maps, and valuable natural history information will be of interest to both the serious student and professional herpetologist alike.

It is hoped that this book will stimulate the serious amateur into submitting his significant and previously unreported natural history notes and range extensions for publication in the different appropriate journals or regional herpetological publications.

The introduction opens with a brief review of conservation measures, along with a list of the 13 species and subspecies of Texas threatened snakes. This is followed by well deserved comments on poisonous serpents, their venoms, bites and remarks on becoming familiar with their identification and habits, so you're less apt of being a victim of snakebite. This is followed by comments on each of the fourteen most common venomous Serpentes found within the state, with remarks on behavior, manifestations following venom injection and mortality.

Included are comments on defining the snake by the use of body pattern and color, comments on aberrant snakes, taxonomy, organization of families, species and subspecies, and distributional maps, which are based on actual preserved specimens held in museums, universities, and other scientific collections throughout the United States. This is followed by a checklist of Texas snakes and well figured keys to the species found within the state.

The species and subspecies accounts have an excellent bicolor distributional maps, followed by extremely well defined descriptions for each species. These are followed by comments on comparable look-alike snakes, size, habitat, and 110 excellent full color closeup photos for each species and subspecies found within the state, along with 39 detailed line drawings by Regina Levoy.

The book closes with a glossary of terms, references and an index of common and scientific names.

This book will certainly complement the Peterson Field Guide Series, and certainly should be carried by everyone in the field, as well as families having an interest in their fauna or just a curious inclination of what they might find in their back yards.

We would certainly highly recommend this awesome field guide by the most noted authorities on the herpetofauna of Texas, James R. Dixon and the late John E. Werler.

*Harlan D. Walley and Patricia Ruback, **Department of Biology, Northern Illinois University, DeKalb, Illinois 60115. hdw@niu.edu and pattyruback@hotmail.com.***

Received: 21 November 2006

News and Notes

SOMETHING FISHY: WHEN THE STATE REPTILE IS A FISH

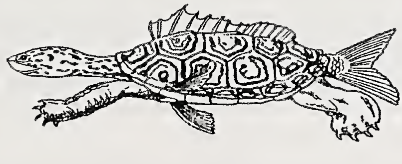
D. S. Lee

"It's no fish you are buying..." The Antiquary, chapter 11; Sir Walter Scott 1771-1832.

"In the beginning God created the heaven and the earth...Let the waters bring forth abundantly the moving creatures that hath life... [and] the creeping things and the beast of the earth." So from day One, well actually it was day Five or Six, living things became grouped into ones that live in the water, in the air, or on land. Vocabularies developed around such simplistic classification schemes. Fish were creatures that lived in the water. People used the word 'fish' for aquatic beings-- fish, starfish, jellyfish, and shellfish. The whale that swallowed Jonah was a great fish. It was not until about the time of our revolutionary war that people began to appreciate the patterns of animal relationships when Linnaeus developed his system of classification. In pre Biblical times the ancient Greeks often used similarities in appearance to suggest animal relationships. Serpents they believed were born from the mouths of eels, and the ancient world was organized with groupings such as fire, water, air, minerals, plants, fish, animals, birds, people, and Gods.

Our knowledge of relationships between objects and living things has progressed considerably in the last 200 years. We know, for example, even all fish are not the same; lampreys and sharks and rays are not any more related to a goldfish than a goat is to a treefrog. While we are still comfortable calling sharks "fish", people realize they are quite different and unrelated to trout, guppies, seahorses and other modern boney fishes.

There were a few set backs: The Bermuda government at one time considered sea turtles fish, and even proposed laws to protect these "fish". The Catholic Church, in the interest of keeping the maximum number of their New World, former heathen members faithful to the Church, eased up the restriction of meat consumption on Fridays and during Lent. They declared that iguanas, crocodilians, turtles and capybaras were actually fish. Thereby they could be consumed without guilt. The situation became even more absurd after the Pope's designated authorities decided that the black-capped petrel, could also be consumed during Lent. While it was obvious that these seabirds could not be regarded as fish, the Church concluded that they also could be eaten for Lent as they were clearly some sort of vegetable. In Catholic dominated Latin American and a number of West Indian nations people remained free of sin but many of these "fish" became instantly rare, and several still suffer major conservation issues today because of the original decrees.



OK, but now almost everyone has it straight. Fish are fish, and things that aren't fish are all something else. It's rather straight forward I would think. Well almost. There were those annoying car insurance ads that claimed that the gecko was the state amphibian of what ever state from which the add was broadcast. Last week I watched a TV news-cast where a wayward manatee found its way far up a river and needed to be rescued and returned to a coastal location. The news commentator ended the broadcast by saying she always enjoyed uplifting fish stories. Then there are the legal aspects of poor labeling and marketing. The State of Maryland regulates diamondback terrapins under their Fisheries department and they manage them like fish. In turn the commercial fishermen and the seafood dealers who store and ship them treat terrapins

like their other seafood products. (Actually we don't ship them anymore, this is another word left over from times past. Today we "truck" or "fly" them.) The issue is that unlike real fish that soon die when they are removed from water the terrapins, being air-breathing souls, don't die. At least they don't die in a timely manner. And being turtles they can survive for long periods stacked in boxes while placed on ice and in coolers. Ones left on docks overnight often freeze, only to thaw the next day. Dealers have told me of terrapins whose frozen limbs are so brittle that they break off when you pull on them. They live, too. Yanked from their hibernation spots on the bottom, or snared in nets like fish, terrapins start their journey to fish markets. And then, after being stored alive on ice for days or weeks they are finally sold to people who prepare them by dropping the living turtles directly into boiling water. A traumatic death—the sequel to an extended, prolonged period of suffering.

Unlike most species in the seafood trade, there are no catch limits for Maryland, so during years of poor oyster or crab harvest, a commercial fisherman can regroup and cut his losses with terrapins. The concepts behind fish management, the decision process of fisheries managers, is built on creatures like fish, oysters and crabs that produce thousands, some times tens of thousands of eggs each year, and species which typically mature in a year or two. These same commercial regulations don't actually work for a long-lived turtle with a prolonged period as an adolescent and a small annual egg output. Forget that they live as long as most people, and let's overlook the fact that Maryland also recognizes this "fish" as its State reptile and university mascot.

So what is the big deal? Well, excluding the humane aspects regarding their treatment, the real issue is the terrapins' welfare on a population level. In addition to a nearly unregulated harvest, the Bay's terrapins face a number of additional problems. These include shoreline development, drowning in crab pots, being run over by cars on their way to nesting sites, erosion of nesting beaches, pollution, high mortality as bycatch in fishing nets, and nesting females being ground-up by the mowing of road shoulders. The annual cumulative effect is of significant magnitude. The decades of neglect and total lack of appropriate conservation efforts is now placing our Bay's terrapins in serious jeopardy. So who oversees all this, who addresses these problems? No one. Not the protective wildlife agencies, these things are regarded as a "Fisheries" species, and not the Fisheries officials when the terrapins are on land, and apparently not when outside the Fisheries' commercial fishing season. At these times terrapins are not under the jurisdiction of Fisheries. See, when it's convenient sometimes they actually become animals.

Someone needs to educate Maryland DNR. Terrapins are a species of turtle, and turtles are a type of reptile. School kids know this, why can't the issue be recognized by our government? At least if they are unable to regulate and protect this turtle maybe they could pretend that they care as to what they are. The National Weather Service does not regulate National Parks, the Navy does not control forest management, and the Departments of Human Services do not oversee the world's oceans. There are reasons for this, and most would agree the reasons are obvious. OK, so why does our state fisheries office continue to dictate the fate for our state reptile? I guess it's simply another fish story.

From the point of view of people and conservation organizations concerned with the welfare of the Bay's terrapins the situation is also frustrating because these turtles are managed under Fisheries. In public meetings the fishery people refer to terrapin nesting as "spawning." Animal welfare groups and conservation organizations have little experience with the Fisheries administrators, and of course see the terrapin issues from totally different perspectives. At this time the Humane Society, The Terrapin Institute, The Chesapeake Terrapin Alliance, The Natural History Society of

Maryland, Inc., The Mid-Atlantic Turtle and Tortoise Society, The Maryland Herpetological Society, The M.A.R.S. Preservation Fund, The National Aquarium, The Coastal Conservation Association of Maryland, Defenders of Wildlife, several Audubon societies and canoe clubs, and dedicated research scientists are all hoping to get the terrapin fishery closed. No one will listen.

In 2001 The Governor of Maryland appointed a Task Force to look at the situation. The DNR fisheries staff essentially ignored all the primary recommendations and modified the secondary ones to the point that they were meaningless. This was in despite of the fact that the Task Force's recommendations became an Executive Order. In Orwellian logic they claimed that their new regulations took into consideration the recommendations of the Task Force. Then they held public hearings regarding their proposed changes in the regulations. A 10 July 2006 hearing was particularly well attended and many people spoke up and stated dissatisfaction with what was being proposed. The State was given piles of written statements and publications from the scientific community which all documented that a terrapin fishery was unsustainable. DNR later announced that they had support from the public and the scientific community for the new regulations. They even placed out of context quotes from their critics in press releases to support their foolishness. The interesting part was these regulations were apparently finalized and submitted even before the public comment period had ended. Their only answer to the problems was that the situation needed further study: an assessment of the fishery stock. There is no funding for this and any assessment is years in the future. Then the politicians and Fisheries administrators retreated behind closed doors, redrafted and passed legislation that put additional burdens on the Bay's terrapin populations, concluding that the commerce could continue until the survey information became available. Later they thanked everyone for their helpful input. In the mean time the commercial trade of terrapins is accelerating as markets expand. As an interesting aside DNR actually had a point person to over see terrapin issues. She quickly assessed what the issues were and became very outspoken about flaws in the existing Fisheries policies. Shortly after an administration change she lost her job under a very transparent guise of a reduction in force driven by budget cuts. Terrapin Day, a direct out growth of her enthusiasm for the State's reptile and proclaimed by a former Governor, was eventually dismissed by the current administration.

All the time this was going on the demand for terrapins went from near nothing to one of greatly increased magnitude. Commercial fishermen discovered that the Asian community, both here in the US and abroad had a bottomless appetite for terrapins. Exporters and dealers used local newspaper ads and the internet message boards to let it be known to the commercial fishermen that they were ready to purchase terrapins by the ton and ship them to China. The trade is now in full swing: the number of individuals now holding commercial terrapin licenses has just over quadrupled the previous average, and the number of unreported terrapins that are collected and shipped is unknown as the fishery is not very well regulated. Boxes full of terrapins shipped to Asia are unmonitored as they are simply and legally labeled "seafood." Additionally, Chesapeake terrapins are now being sold as pets over the internet as the small ones have little food value. Just recently live terrapins were offered on eBay.

A petition against commercial use of terrapins is in circulation. Its difficult to find anyone not willing to sign it and most people who now know the situation because of their signing the petition had no idea and are shocked that the Bay's terrapins are still being exploited. Several bills to have a complete closure of the industry are currently being prepared. On scientific, biological and humane grounds closure is the only option. Yet, even if the bills pass, there is little doubt that in the future commercial interests will petition State Fisheries to reopen the fishery. Fisheries personnel and fishermen see these turtles as dollar signs, not as living beings that are an important compo-

nent of the Bay's ecosystem. It's time that common sense takes a seat in government. It's time for these terrapins, the most celebrated of American reptiles, to stop being managed like they are fish. The stewardship of the Bay's terrapin needs to be transferred to another agency and commercial exploitation of our terrapins needs to be prohibited.

"She is neither fish nor flesh, nor a good red herring" Proverbs. Part 1, Chap X

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Editors Note: A short 300 word version of this paper was run in *The Baltimore Sun* in December 2006.

Illustration by Leo Schleicher.

News and Notes

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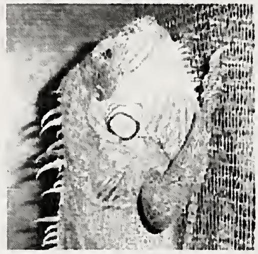

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Information for Authors

All correspondence should be addressed to the Executive Editor. Manuscripts being submitted for publication should be typewritten (double spaced) on good quality 8 1/2 by 11 inch paper with adequate margins. Submit original and first carbon, retaining the second carbon. If entered on a word processor, also submit diskette and note word processor and operating system used. Indicate where illustrations or photographs are to appear in text. Cite all literature used at end in alphabetical order by author.

Major papers are those over five pages (double spaced, elite type) and must include an abstract. The authors name should be centered under the title, and the address is to follow the Literature Cited. Minor papers are those papers with fewer than five pages. Author's name is to be placed at end of paper (see recent issue). For additional information see *Style Manual for Biological Journals* (1964), American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

Reprints are available at $.07 a page and should be ordered when manuscripts are submitted or when proofs are returned. Minimum order is 100 reprints. Either edited manuscript or proof will be returned to author for approval or correction. The author will be responsible for all corrections to proof, and must return proof preferably within seven days.

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DEPARTMENT OF HERPETOLOGY

THE NATURAL HISTORY SOCIETY OF MARYLAND, INC.

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Membership Rates

Membership in the Maryland Herpetological Society is $25.00 per year and includes the Bulletin of the Maryland Herpetological Society. Foreign is $35.00 per year. Make all checks payable to the Natural History Society of Maryland, Inc.

Meetings

Meetings are held monthly and will be announced in the “Maryland Herpetological Society” newsletter and on the website, www.marylandnature.org.

Axial Bifurcation and Duplication in Snakes.

Part I. A Synopsis of Authentic and Anecdotal Cases

Van Wallach

Abstract

A review is presented for 950 cases of dicephalism, axial bifurcation, and somatodichotomy in snakes, taken from the primary and secondary literature, museum specimens, press clippings, news reports, the internet, videos, photographs, and postcards. A reliability system of four categories is proposed for reported cases. A checklist of 169 species in 93 genera is presented in addition to the distribution of records within the eight families. Data are analyzed according to their temporal discovery and their occurrence by geographic region, number of cases by country, and within the USA by state. Classification categories are discussed along with possible causes of somatodichotomy. The internal anatomy (cervical vertebrae and viscera) is summarized and information on the behavior and natural history of dicephalic snakes is discussed.

Introduction

The aberrant developmental mutations of snakes in which part or all of the cranium and/or spinal column are duplicated are summarized herein as the first part of a series of papers documenting previously unrecorded specimens. These latter specimens are not to be confused with mythical two-headed snakes having a head at each end of the body nor with certain burrowing snakes and amphisbaenids with short, blunt tails that have mistakenly been believed to represent a second head (Cunningham, 1927). These include scolecophidians, anilioids, boids, and amphisbaenians of tropical and subtropical regions.

Variously known by a multitude of terms, the most common being axial bifurcation, dicephalism, and somatodichotomy (Table 1), the condition is a rare occurrence in snakes but there have been hundreds of reported cases since the first reliable reports by Aristotle in BC 350 and Aelianus in BC 250 (Aristotle, 1812; Aelian, 1971). Other records and illustrations through the 18th Century were provided by Porta (1545), Schenckius (1609), Anon. (1631), Licetus (1634), Aldrovandi (1640), Jonstonus (1653), Redi (1684), Lanzoni (1690), Valentini (1704), Herrera (1726), Edwards (1751), Davila (1767), Bancroft (1769), Reuss (1784), Anon. (1788), Lacépède (1789), Anon. (1793), and Baker (1795). Since more than 90% of all cases involve duplication of all or part of the head, with or without a pair of short necks, use of the descriptive term dicephalism is here considered synonymous with axial bifurcation.

Johnson (1902) described 13 new specimens and summarized 25 cases (representing 15 species) from 21 references. Cantoni (1921) summarized the early literature on two-headed snakes and figured 12 specimens. Strohl (1925) summarized 68 cases (representing 28 species and subspecies) from 30 references and museum collections. Heasman (1933) added another eight species to the list of dicephalic snakes. Cunningham (1937) summarized 225 authentic cases (representing 48 species and subspecies) from 150 references. Tuck and Hardy (1970) added an additional 39 cases (representing 30 species) from 63 references. Smith and Pérez-Higareda (1987) added 117 new references and brought the total number of species to 87 (99 species and subspecies). Matz (1989) summarized 106 species from museum collections and the literature, based on 83 references, bringing the total number of cases to 375. Payen (1991) summarized 121 specimens (representing 58 species and subspecies) solely from museum collections and cited 141 references. Matz (1994) then estimated the total number of records to be 400. Wallach (1995) added 11 new cases from museum collections. Swanson et al. (1997) added one case and summarized the works of Payen (1991) and Wallach (1995). Nearly 600 authentic cases were known, comprising 145 species in 75 genera, according to the lastest accounting (Wallach, 2003, 2004).

Materials and Methods

My interest in dicephalic snakes began in 1972 with my first copy of Cunningham's (1937) book. Since that time, I have studied the comparative anatomy of snake viscera, particularly the respiratory system (Wallach, 1998). The examination of somatodichotomous snakes with their partially duplicated internal organs presents an opportunity to better understand the development of visceral elements. I intend to publish a series

Table 1. Synonymy of axial bifurcaion terminology

Altodymus	Rayer, 1850; Ladeiro, 1935; Antunes, 1963; Vizotto, 1975
Amphidichotomy	Cunningham, 1937; Smith & Pérez-Higareda, 1987
Anacatadidymous	Fisher, 1868
Anadidymous	Fisher, 1868
Anakatamesodidymus	Nakamura, 1938
Anterior dichotomy	Cunningham, 1937; Talukdar, 1977
Axial bifurcation	Johnson, 1902; Cunningham, 1937; Acharji, 1945; Tuck & Hardy, 1970; Payen, 1991; Ball, 1995; Swanson et al., 1997
Axial duplication	Matz, 1989; Sánchez-García & Martínez-Silvestre, 1999
Bicephalism	Amaral, 1927; Vellard & Penteado, 1931; Lema, 1957; Belluomini, 1965; Nickerson, 1966; Khaire & Khaire, 1984
Bicephaly	Vizotto, 1975: Mitchell & Fieg, 1996
Catadidymous	Fisher, 1868
Cephalic dichotomy	Cunningham, 1937; Krysko et al., 2002
Cephaloderopagus	Nakamura, 1938
Cephalodichotomy	Cunningham, 1937
Craniodichotomy	Smith & Pérez-Higareda, 1987; Reid, 2005
Craniopagus	Nakamura, 1938
Cryptoderodymus	Antunes, 1963; Belluomini, 1965
Derodymus	Antunes, 1963; Belluomini, 1965
Dicephalism	Cantoni, 1921; Curry-Lindahl, 1963; Branch, 1979; Bakken & Bakken, 1987; Wallach, 1995
Dichotomy	Niimi, 1965, 1971
Dicocephaly	Meyer, 1958; Ernst, 1960
Double-headed	Shortt, 1866; Bean, 1889; Yoshinaga, 1901; Deraniyagala, 1958
Duplicitas anterior	Abe, 1952; Brongersma, 1952; Kincel, 1969
Holodichotomy	Smith & Pérez-Higareda, 1987
Homodynamous	Wilder, 1904
Iniodymus	Belluomini, 1965
Opisthodichotomy	Smith & Pérez-Higareda, 1987
Opodymus	Nakamura, 1938; Antunes, 1963
Posterior dichotomy	Cunningham, 1937
Proarchodichotomy	Smith & Pérez-Higareda, 1987
Prodichotomy	Smith & Pérez-Higareda, 1987; Watkins-Colwell, 1995
Rhinodymus	Nakamura, 1938; Antunes, 1963
Somatodichotomy	Smith & Pérez-Higareda, 1987
Teratodymus	Antunes, 1963
Teratodymus derodymus	Belluomini, 1959; Belluomini & Lancini, 1960
Teratopagus	Nakamura, 1938
Thoracodymous	Lema, 1994
Twin-headed	Jahan & Ovais, 1979
Two-headed	Fischer, 1896; Pérez-Higareda & Smith, 1987; Andreadis & Burghardt, 1993
Urodichotomy	Smith & Pérez-Higareda, 1987

of papers in this journal, reporting on undocumented cases of dicephalic snakes. In this first installment the data for 950 specimens will be summarized in a variety of ways. Subsequent papers will deal with specific examples. The data analyzed herein are current to April 2006.

In order to establish the reliability of a record, I propose four categories of reports: 1) voucher specimens, 2) physical evidence, 3) reliable observations, and 4) anecdotal reports. Category 1 includes extant, missing, and lost preserved specimens that at some point in time were catalogued and deposited in a museum or private collection. Category 2 includes photographs, radiographs, videos, postcards, shed skins, primary literature publications, newspaper accounts with photos, and any other physical evidence of a living or dead specimen. Both categories 1 and 2 are considered authentic and genuine cases. Category 3 includes newspaper accounts lacking photographs, secondary literature publications, and observations by competent and reliable witnesses (herpetologists, public officials, etc.). These reports are considered reliable or probable, but not definitely proven. Category 4 consists of anecdotal reports, newspaper accounts without any factual data, and other questionable cases. They are not considered valid but at a later date could possibly be shown to refer to an authentic case; hence they are worth recording and keeping. Thus, categories 1 and 2 represent definite cases, category 3 probable cases, and category 4 unverified cases.

The first (or original) report of a snake is labelled as "A" and subsequent citations of the same specimen are labelled "B," "C," "D," etc. The data presented below refer only to "A" category reports unless noted otherwise. Category "A" represents the actual number of dicephalic snakes.

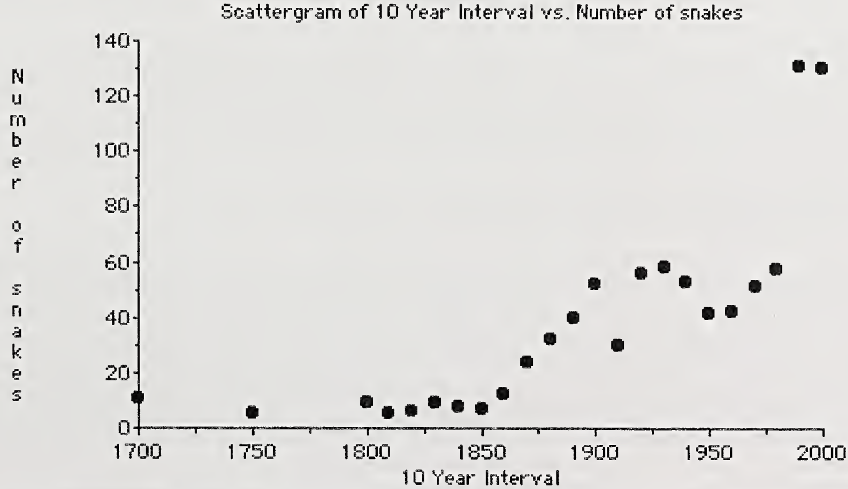
In discussing the longevity of snakes, a "+" after a yearly age indicates either that the snake is still alive or its death is unrecorded and the value given is based on the last known date in life to the best of my ability. Museums acronyms follow Leviton et al. (1985) with the addition of GMB (Gordon M. Burghardt private collection, Knoxville), JSA (John S. Applegarth private collection, Eugene), MRCS (Museum of Royal College of Surgeons of England, London) and VW (Van Wallach private collection, Cambridge).

Results

A summary of 950 cases reveals that at least 169 species in 93 genera are now known (Wallach, unpubl. data). Distribution of the 950 original and 737 secondary reports by reliability type is summarized as follows (original cases + subsequent reports = total records): Type 1 (306 + 225 = 531), type 2 (374 + 276 = 650), type 3 (216 + 171 = 387), and type 4 (54 + 65 = 119). Table 2 illustrates the number of reports over time. The sources for the 950 original records are the following: museum vouchers (274), newspapers (252), professional journals (100), books (92), internet (85), personal communications (48), magazines (35), amateur journals (31), photographs (11), videos (6), Ph.D. dissertation (5), postcards (3), annual reports (2), newsletters (2), meeting abstracts (1), and catalogues (1).

Table 2

Scattergram of 10 Year Interval vs. Number of snakes



The number of taxa for each reliability category is as follows; type 1 (81 species in 71 genera and 8 families), type 2 (64 species in 47 genera and six families), type 3 (21 species in 20 genera and four families), and type 4 (seven species in seven genera and two families). Table 3 summarizes the number of original dicephalic reports in each snake family.

Table 3. Number of dicephalic cases by family and reliability type.

Family	Total	Type 1	Type 2	Type 3	Type 4
Leptotyphlopidae	1	1	0	0	0
Pythonidae	27	2	21	4	0
Boidae	26	10	13	1	2
Tropidophiidae	1	1	0	0	0
Viperidae	154	66	48	33	7
Elapidae	6	4	2	0	0
Hydrophiidae	16	10	2	4	0
Colubridae	531	197	237	90	7
Unknown	188	15	51	84	38
Totals	950	306	374	216	54

Pets and Owners

Some prestigious people have owned dicephalic snakes, including Benjamin Franklin *(Lampropeltis getula)* (Cutler, 1868), Thomas Edison and President Thomas Jefferson (undetermined species) (Clinton, 1814), King Louis XVI of France *(Bothrops lanceolatus)* (Lacépède, 1789), and the Emperor of Japan. The nephew of the famous boxer John L. Sullivan, Texas "Tex" Sullivan, once had a two-headed *Crotalus* (Morrrow, 1963). What is remarkable is that Albertus Seba, the owner of the finest and most comprehensive 17th Century 'Cabinet of Natural Curiosity', whose favorite animals were snakes, never obtained a two-headed snake for his fantastic collection that he had illustrated and published in two volumes (Seba, 1734, 1735). Also, Carolus Linnaeus never owned a dicephalic snake but he was aware of their existence as he mentioned one in the collection of Lars Roberg in a letter written to Kilian Stobaeus on 19 November 1728. In 1924 the famous movie actress Marguerite de La Motte was given to wear a two-headed snake bracelet by her newsboy with the morning paper: he had the unidentified dicephalic snake stuffed by a taxidermist (Anon., 1924; Whitaker, 1924).

Dcephalic snakes have starred on various TV shows and movies. A year old dicephalic *Pantherophis guttatus* in Fort Worth, Texas starred in a motion picture in 1932 or 1933 (Anon., 1933). "Gertrude," a *Pituophis melanoleucus* that resided in Los Angeles, California from 1967 to 1978, starred in two movies, "Ssssss" and "Resurrection." "Dudley Duplex I" was on "You Asked for It" in the 1950's, "Thelma & Louise" was frequently entertained by Johnny Carson in the 1990's, "Barney" was on the "Live with Regis and Kelly" show in September 2005 as a nominee for the 3rd annual Relly Awards, and an undetermined dicephalic that appeared on Craig Kilborn's 'The Late Late Show' in January 2000 was purchased by Ellen DeGeneres. "Brady & Belichick" had a cameo appearance on the Ch. 38 news in Boston in July 2005. A number of two-headed snakes have travelled around in circuses, sideshows, and county fairs over the years, including the adult *Crotalus horridus* ("Double Trouble II") that travelled from Colorado to Minnesota in 1999-2000 (Deem, 1999).

When a dicephalic *Pituophis catenifer* was captured alive in Los Gatos, California in 1877 the "St. Louis Globe-Democrat" stated that "Barnum ought two-headucate him for the menagerie" (Anon, 1878). The 1914 Blue Ribbon "Snake Story of the Year" Award went to John D. Stivers of the "Middletown Daily Times-Press" for his reporting of the capture of a lady *Thamnophis sirtalis* and her 57 young, one of which had two heads, on the New York State Hospital grounds (Anon., 1914; Stivers, 1914). One quite interesting case fraught with potential danger was that of a live dicephalic *Daboia russelii* from Sri Lanka that was originally identified as a harmless python! After its photo circulated among the newswires it was properly identified as a venomous viper (Newman, 1997).

Some not so well known persons have crossed paths with two-headed snakes. The albino adult *Pantherophis obsoletus* ("We") that resided at the Children's Zoo in the St. Louis World Aquarium was so coveted by Brandon Smith of Belleville, Illinois that the youth broke into the museum and stole it in August 2004. It was recovered a day later in the suspect's garage and returned to the City Museum (Jonsson, 2004). This snake garnered considerable worldwide publicity and was the object of many jokes when it was offered up for auction on eBay in January 2006 for the sum of $150,000. No bids for that amount were forthcoming and the several bids that did come in were for less than $50,000 so the owner has decided to try and mate "We" with another two-headed ratsnake in the hope of producing a clutch of dicephalic hatchlings, scientific evidence notwithstanding (Leonard Sonnenschein, pers. comm.).

In the 1980's Mario Tabraue owned a dicephalic *Python regius* while he operated a million dollar drug trafficking business. Tabraue was eventually convicted of racketeering and 13 narcotics charges and sentenced to 100 years in prison but the fate of his snake is unknown (Viglucci, 1985; Anon., 2000). In a murder investigation involving witchcraft in India, Peddaboyina Mahesh, a 5 year old boy, was mutilated, sacrificed and thrown into a well because the boy's father would not sell a two-headed snake to Mandaloju Chary, his son, and Srinivasulu for their sinister purposes (Anon., 2004).

A two-headed *Crotaphopeltis hotamboeia* named "Byron" had residents in KwaZulu Natal, South Africa in an uproar because they feared that the snake was a bad omen or an *inkanyamba* that was responsible for recent severe flooding that killed 100 people and political fighting that has claimed thousands of lives over the past 12 years (Cohen, 1996). In a similar vein, Asian residents of Mulajenav[e] believe that a dicephalic ratsnake, *Elaphe dione,* is a bad omen for the village yet they would not surrender the snake to scientists for study (Avery, 2004).

Pet names given to living dicephalic snakes include the following: *Boa constrictor* ("Him" and "Indy"), *Lichanura trivirgata* ("Rosy"), *Python regius* ("Medusa II"), *Coluber constrictor* ("Split Sam"), *Crotaphopeltis hotamboeia* ("Byron"), *Lampropeltis getula* ("Dually," "Dudley Duplex I," "Dudley Duplex II," "Loren & Leroy," "Mary-Kate & Ashley," "Nip & Tuck," "Tom & Jerry," and "Zany & Brainy"), *Lampropeltis triangulum* ("Brady & Belichick," "Dubby," "Eddy," and "Oscar"), *Natrix natrix* ("Four Eyes"), *Nerodia sipedon* ("Hatfield & McCoy"), *Pantherophis guttatus* ("Abbott & Costello, " "Boo," "Hope," and "Thelma & Louise"), *Pantherophis obsoletus* ("Barney," "Golden Girls," "Janus," "Jeffrey & Jeffrey the Great," "Laverne & Shirley," "Medusa III," "Them," and "We"), *Pantherophis spiloides* ("I-M" and "Two-Head"), *Pituophis catenifer* ("Buddy & Bobby," "Medusa I," and "Reginald & Llewelyn"), *Pituophis melanoleucus* ("Gertrude" and "Hocus-Pocus"), *Regina septemvittata* ("Ying-Yang"), *Rhinechis scalaris* ("Hiss & Hiss"), *Thamnophis sirtalis* ("George & Bob"), *Crotalus atrox* ("Hammerhead"), *Crotalus horridus* ("Double Trouble II"), and *Crotalus viridis* ("Double Trouble I"). The most popular pet names are "Medusa" (3 snakes), "Double Trouble" (2 snakes), and "Dudley Duplex" (2 snakes). If the reader knows of any additional pet names for two-headed snakes, please inform me. I am particularly interested in learning the name of the *Pituophis catenifer* that resided at the Steinhart Aquarium from 1974-1991; it supposedly had several aliases.

As befitting the state that is source of the most cases of axial bifurcation (California with 59!), the San Diego Zoo ranks first in having had the most live dicephalic snakes with seven individuals between 1953 and the present (only five or six of them exhibited), the Los Angeles Zoo comes in second with four snakes exhibited between 1973 and 1994, the Steinhart Aquarium in San Francisco is third with three dicephalics on exhibit from 1969 to 1991, and Prehistoric Pets in Valencia has had two snakes from 1999 to the present (Table 4).

Live two-headed snakes that have been displayed in other institutions include the following: *Python molurus* (Japan's Sapporo Zoo, 1977; Arignar Anna Zoological Park in Chennai, India, 2001), *Boiga dendrophila* (Twycross Zoo in Atherstone, U.K., 1984), *Coluber constrictor* (Dayton Natural History Museum, 1916), *Crotaphopeltis hotamboeia* (FitzSimons Snake Park in Durban, 1987 and 1996), *Elaphe climacophora* (Toyohashi Municipal Zoo, 1963; Yokohama Zoo), *Hierophis viridiflavus* (Italy's Giardino Zoologico "Città di Pistoia", 1975), *Lampropeltis calligaster* (St. Louis Zoological Park, 1927-28), *Lampropeltis getula* (Hermann Park Zoo in Houston, 1927; Arizona-Sonora Desert Museum, 1977-93; Snake World in Berryville, Arkansas, 2004-06; Reptile Kingdom in New Jersey, 2005-06; Santiago Zoo in Chile), *Lampropeltis triangulum* (New York Zoological Gardens, 1902-03), *Natrix natrix* (Booth Museum of Natural History in Brighton, 1994), *Pantherophis obsoletus* (World Aquarium, St. Louis, 1999-06), *Pantherophis spiloides* (University of Tennessee, Knoxville, 1976-92; Mississippi Museum of Natural Science in Jackson, 2004-06), *Pantherophis* sp. (The Netherland's

Oliemeulen Zoo in Tilburg, 2002), *Pituophis catenifer* (Knowland Park Zoo in California, 1970; Santa Barbara Museum of Natural History, 1991-97), *Pituophis melanoleucus* (Jacksonville City Zoo, 1968), *Pituophis sayi* (St. Louis Zoo, 1983-86), *Psammophis* sp. (Port Elizabeth Museum and Snake Park in South Africa), *Thamnophis elegans* (Monte L. Bean Life Science Museum in Provo, 1981), *Thamnophis sauritus* (North Carolina State Museum of Natural Sciences, 2005-06), *Thamnophis sirtalis* (New York Zoological Gardens, 1902), *Thamnophis* sp. (Chicago's Brookfield Zoo, 1949 and 1967; Seattle's Woodland Park Zoo, 1974-75), *Tropidoclonion lineatum* (Missouri's Max Allen Zoo in Eldon, 1965), *Bothrops alternatus* (Argentina's Jardin Zoologique de Buenos Aires, 1981), *Daboia russelii* (National Zoological Gardens in Colombo, Sri Lanka, 1997), *Vipera berus* (London Zoological Gardens, 1854; Hamburg's Zoologische Garten in Germany, 1873), and undetermined species (London Zoological Gardens, 1896; Cincinnati Zoological Gardens, 1909; Chicago's Lincoln Park Zoo, 1937; Philadelphia Zoo, 2001; San Antonio Zoo, Venezuela's Caracas Zoo) (Wallach, 2004, unpubl.).

Table 4. History of dicephalic snakes in California zoos

Species	Dates	Sex	Locality	Name	Zoo
1. *Lampropeltis getula californiae*	viii.1998 – present	?	CA	Tom & Jerry	San Diego Zoo
2. *Lampropeltis getula californiae*	1995	?	CA	?	San Diego Zoo
3. *Pantherophis guttatus*	1984 – 2000	F	FL	Thelma & Louise	San Diego Zoo
4. *Lampropeltis getula californiae*	31.x.1969 – iii.1975	M	Escondido, CA	Nip & Tuck	San Diego Zoo
5. *Lampropeltis getula californiae*	30.xii.1967 – vii.1971	M	Del Mar, CA	Dudley Duplex II	San Diego Zoo
6. *Lampropeltis getula californiae*	xi.1963-xii.1963	?	San Diego, CA	?	San Diego Zoo
7. *Lampropeltis getula californiae*	6.xi.1953 – v.1960	?	Lemon Grove, CA	Dudley Duplex I	San Diego Zoo
8. *Pituophis catenifer annectens*	24.x.1973 – 29.xi.1994	?	Griffith Park, CA	Reginald & Llewellyn	Los Angeles Zoo
9. *Pituophis catenifer annectens*	< 1994	?	CA	?	Los Angeles Zoo
10. *Lampropeltis getula californiae*	?	?	CA	?	Los Angeles Zoo
11. *Lampropeltis getula californiae*	ca. 1991	?	CA	?	Steinhart Aquar.
12. *Pituophis catenifer catenifer*	?	?	CA	?	Steinhart Aquar.
13. *Pituophis catenifer catenifer*	1969 – 31.i.1991	?	Napa, CA	Medusa	Steinhart Aquar.

In 1992 Kathy Lehren won the "Best Educational Exhibit" award for the state of Pennsylvania by the Pennsylvania Festivals Association for her "World-Wide Reptilia" exhibit that included a dicephalic *Python* (Anon., 1992).

The most popular dicephalic, based upon 200 publications in 18 languages as a result of a recent online auction is "We," the adult albino *Pantherophis obsoletus* that has lived in the St. Louis World Aquarium for the past 6.5 years (1999-present) (Leonard Sonnenschein, pers. comm.). Coming in a distant second and third are Raymond Ditmars' *Lampropeltis t. triangulum* that was exhibited at the New York Zoo for one year (1901-1902) and "Dudley Duplex I" the *Lampropeltis getula californiae* that lived in the San Diego Zoo for 6.5 years (1953-1960) with 30 and 27 publications, respectively.

Jerry Klein, who captured a dicephalic *Pantherophis spiloides* in Oak Ridge, Tennessee in 1976, reported that six dicephalic snakes were currently living in the USA (Anon., 1976). The best estimate of the number of live dicephalics in the USA today is at least 25 with another 10 in foreign countries (Wallach, unpubl.).

Systematics

It was once believed that two-headed snakes were a distinct genus and species despite the evidence provided in 1763 when a gravid *Nerodia sipedon* was killed in Sherley, Massachusetts and opened to find 60 embryos, only one of which had two heads (Baker, 1795). Mitchill (1826) and De Betta (1865) provided further irrefutable evidence that dicephalics were monsters rather than distinct species, and it has been reiterated a number of times in print since then (Cowles, 1939). Benjamin Franklin, however, thought two-headed snakes formed a distinct genus when he received a preserved *Lampropeltis getula* after having seen the drawings of a *Lampropeltis triangulum* from Lake Champlain (Cutler and Cutler, 1888) and Dareste (1891) believed in the existence of a dicephalic species based upon the large number of snakes that were known with two heads. Since axial bifurcation is the result of an abnormal developmental mutation, the condition is not genetically inherited. This has been demonstrated in at least two cases: "Thelma & Louise" *(Pantherophis guttatus)* at the San Diego Zoo laid 15 eggs that all hatched into normal neonates and "Zany & Brainy" *(Lampropeltis getula)* at Prehistoric Pets in Valencia, California has laid four clutches of approximately 5 eggs each that all hatched as normal individuals.

A complete list of snake species that are known to exhibit axial bifurcation is as follows (family, number of species parenthetically, genus and included species): Leptotyphlopidae (1) – *Leptotyphlops bicolor;* Pythonidae (10) – *Antaresia maculosa; Chondropython viridis; Morelia amethistina, M. cheynei, M. mcdowelli, M. spilota, M. variegata; Python molurus, P. regius, P. sebae;* Boidae (7) – *Acrantophis dumerilii; Boa constrictor; Epicrates angulifer, E. cenchria, E. maurus, E. striatus; Gongylophis conicus;* Tropidophiidae (1) – *Tropidophis melanurus;* Colubridae: Lamprophiinae (5) – *Duberria lutrix; Lamprophis fuliginosus, L. inornatus; Lycodon aulicus; Lycophidion capense;* Colubridae: Xenodontinae (20) – *Carphophis amoenus; Diadophis punctatus; Echinanthera cyanopleura; Erythrolamprus aesculapii; Helicops carinicauda; Heterodon platirhinos, H. simus; Leptodeira annulata; Liophis almadensis, L. miliaris, L. perfuscus, L. poecilogyrus; Lystrophis pulcher x mattogrossensis; Philodryas olfersii, P. patagoniensis; Sibon* sp.; *Sibynomorphus mikanii; Thamnodynastes chilensis; Waglerophis merremii; Xenodon severus;* Colubridae: Homalopsinae (4) – *Cerberus rynchops; Enhydris bocourti, E. enhydris; Homalopsis buccata;* Colubridae: Boiginae (3) – *Boiga dendrophila; Crotaphopeltis hotamboeia; Macroprotodon cucullatus;* Colubridae: Psammophiinae (1) – *Psammophis* sp.; Colubridae: Colubrinae (43) – *Coluber constrictor; Coronella austriaca; Dasypeltis scabra; Dinodon rufozonatum; Dolichophis jugularis; Elaphe bimaculata, E. climacophora, E. dione, E. quadrivirgata, E. quatuorlineata, E. sauromates, E. schrenckii; Euprepiophis conspicillatus; Hemorrhois ravergieri; Hierophis viridiflavus; Lampropeltis alterna x mexicana, L. calligaster, L. getula, L. mexicana, L. mexicana x ruthveni, L. pyromelana, L. triangulum; Masticophis flagellum; Oligodon barroni; Oocatochus rufodorsatus; Opheodrys aestivus; Orthriophis taeniurus; Pantherophis alleghaniensis, P. emoryi, P. guttatus, P. obsoletus, P. spiloides, P. vulpinus; Philothamnus semivariegatus; Pituophis catenifer, P. melanoleucus, P. sayi; Platyceps florulentus; Pseudelaphe flavirufa; Ptyas mucosus; Rhinechis scalaris; Spalerosophis diadema; Zamenis longissimus;* Colubridae: Natricinae (25) – *Amphiesma vibakari; Natrix maura, N. natrix; Nerodia clarkii, N. fasciata, N. rhombifer, N. sipedon; Regina septemvittata; Rhabdophis tigrinus; Sinonatrix annularis; Storeria dekayi, S. occipitomaculata; Thamnophis atratus, T. couchii, T. cyrtopsis, T. elegans, T. eques, T. gigas, T. marcianus, T. ordinoides, T. radix, T. sauritus, T. sirtalis; Tropidoclonion lineatum; Xenochrophis piscator;* Elapidae (4) – *Bungarus caeruleus; Hemachatus haemachatus; Hemibungarus japonicus; Naja naja;* Hydrophiidae: Oxyuraninae (7) – *Acanthophis wellsi; Austrelaps superbus; Notechis scutatus; Ogmodon vitianus; Oxyuranus scutellatus; Pseudechis porphyriacus; Pseudonaja affinis;* Hydrophiidae: Hydrophiinae (4) – *Aipysurus laevis; Hydrophis cyanocinctus, spiralis; Pelamis platura;* Viperidae: Viperinae (7) – *Bitis arietans, B. atropos; Daboia russelii; Vipera ammodytes, V. aspis, V. berus, V. ursinii;* Viperidae: Crotalinae (25) – *Agkistrodon contortrix, A. piscivorus; Bothrops alternatus, B. asper, B. atrox, B. jararaca, B. jararacussu, B. lanceolatus, B. moojeni; Crotalus adamanteus, C. atrox, C. basiliscus, C. durissus, C. horridus, C. lutosus, C. mitchelli, C. oreganus, C. scutulatus, C. tigris, C. viridis; Gloydius blomhoffii, G. halys; Sistrurus catenatus, S. miliarius; Trimeresurus shedaoensis.*

Certain species of snakes are known to have multiple cases of axial bifurcation, owing partly to the common occurrence and widespread distribution of the species but also to their propagation in captivity for the pet trade. Dicephalics born in captivity, whether alive or dead, are always noticed whereas most wild-born dicephalics are never seen or recorded. Species represented by at least 10 examples of axial bifurcation include the following: *Lampropeltis getula* – 48 specimens, *Natrix natrix* – 47 specimens, *Thamnophis sirtalis* – 38

specimens, *Lampropeltis triangulum* – 26 specimens, *Pantherophis guttatus* – 26 specimens, *Pantherophis obsoletus* – 26 specimens, *Vipera berus* – 25 specimens, *Pituophis catenifer* – 20 specimens, *Nerodia sipedon* – 18 specimens, *Coluber constrictor* – 14 specimens, *Boa constrictor* – 12 specimens, and *Elaphe climacophora* – 11 specimens.

As for museum collections of voucher specimens, those institutions or researchers having (or having owned) at least three specimens include (maximum number of dicephalics in parentheses, some of which may now be destroyed, missing, or lost): USNM in Washington (19), MNHN in Paris (15), MCZ in Cambridge (12), VW in Cambridge (11), IB in São Paulo (9), CAS in San Francisco (8), FAKU in Kyoto (6), MRCS in London (6), NMW in Vienna (6), PEM in Port Elizabeth (6), ZSI in (6), JSA in Eugene (5), MSNM in Milano (5), BMNH in London (4), CM in Pittsburgh (4), NCSM in Raleigh (4), UMMZ in Ann Arbor (4), ANSP in Philadelphia (3), FMNH in Chicago (3), GMB in Knoxville (3), MCNC in Caracas (3), OSU in Corvallis (3), and TMP in Pretoria (3).

A number of dicephalic specimens have been lost en route to museums or researchers: *Lampropeltis triangulum* (Howey, 1883), *Thamnophis sirtalis* (Anon., 1889b), and *Regina septemvittata* (Emmert to Stejneger in 1898). Others have been lost in various trajedies: a *Vipera berus* in the Muzeul de Istorie Naturala "Grigore Antipa" in Bucharest was destroyed by an earthquake in 1977, and a fire at the Dan Nichols Park Nature Center in Salisbury, North Carolina recently destroyed an *Agkistrodon contortrix*. Some have been lost after their death: *Duberria lutrix* (Haagner, 1994). A few specimens have disappeared after being deposited in museums: *Crotalus mitchelli* (Baird, 1856), *Coluber constrictor* (Wyman, 1863) and *Heterodon platirhinos* (Cunningham, 1937), or been discarded for unknown reasons: *Nerodia sipedon* (Fowler, 1922). A dicephalic *Agkistrodon contortrix* born to a wild-caught North Carolina mother, collected in August 2005 but surviving only until November at the Dan Nichols Park Nature Center in Salisbury, was just the fifth known two-headed copperhead. However, a fire sadly destroyed the Nature Center in March 2006 along with the preserved specimen and all its records before I had a chance to examine it (Chaffin, 2005; Charlie Herron, pers. comm.). As with all natural history specimens, this illustrates the importance of depositing them in an institution that will preserve and conserve them. A noteworthy example comes from the University of California at Berkeley where a zoology student at the natural history museum, Dorothy Furch, wished to keep a donated dicephalic *Thamnophis* as a mascot but the university authorities refused on the grounds that science must be served before sentiment (Anon., 1926).

Geographic Distribution

More than half of the known records (57%) of dicephalism occur within the USA with 12% originating from Europe and 11% from Asia (Table 5). The bias in numbers can be attributed partly to the number of herpetologists, interest in nature, and my ability to search English-based literature. Undoubtedly there are many forgotten records hidden away in foreign newspapers. Somatodichotomy probably occurs with similar frequency around the world but the majority of wild-born cases are never observed; also, I have been limited to searching literature mainly in the English language. My searches are woefully incomplete and I am ceratin many accounts are available in foreign newspapers. Distribution of cases by country of origin is as follows: Algeria – 1, Argentina – 2, Australia – 21, Azerbaijan – 1, Bangladesh – 2, Barbados – 1, Bolivia – 1, Brazil – 27, Canada – 8, Chile – 2, China – 12, Colombia – 6, Costa Rica – 1, Croatia – 1, Cuba – 2, Egypt – 3, Fiji Islands – 1, Finland – 1, France – 16, Germany – 16, Ghana – 2, Hungary – 1, India – 23, Indonesia – 4, Iran – 1, Italy – 24, Japan – 25, Korea – 2, Madagascar – 1, Martinique – 1, Mexico – 6, Nepal – 1, Nigeria – 1, Panama – 1, Portugal – 1, Russia – 2, Slovenia – 1, Somalia – 1, South Africa – 15, Spain – 5, Sri Lanka – 3, Sweden – 5, Switzerland – 2, Tadjikistan – 1, Taiwan – 1, Thailand – 6, Tunisia – 2, Turkey – 1, Ukraine – 1, United Kingdom – 21, Uruguay – 1, USA – 536, Uzbekistan – 1, Venezuela – 4, Yugoslavia – 2, Zimbabwe – 2, and unknown origin – 101. Table 6 lists the number of dicephalic snakes from each state in the USA (six states have apparently not recorded any dicephalics: Colorado, Connecticut, Minnesota, North Dakota, Vermont, and Wyoming).

Classification

Various classification systems have been proposed for axial bifurcation in snakes, ranging from the simple (Geoffroy-Saint-Hilarire, 1836, with three categories; Nakamura, 1938, with 8 categories) to the complex (Antunes, 1963, who proposed 118 names). Smith and Pérez-Higareda (1987) proposed the currently

accepted classification, consisting of seven categories: craniodichotomy, prodichotomy, proarchodichotomy, urodichotomy, opisthodichotomy, amphidichotomy, and holodichotomy. A craniodichotomous specimen has two incompletely divided heads, a single atlas and axis, and a single body and tail. A prodichotomous snake has two complete heads, each with an atlas and axis, either a single or two short necks, and a single body and tail. A proarchodichotomous specimen has two heads, two long necks, and a single body and tail. A urodichotomous snake has one head and body but two tails. An opisthodichotomous specimen has one head, two bodies and two tails. An amphidichotomous snake has two heads, a single body, and two tails. Holodichotomy refers to a pair of twins from a single egg, usually healthy and normal but reduced in size in comparison with their siblings. Twins are, on average, 22.9% shorter in total length (range = 10.0-42.3%, n = 13) and weigh 46.3% less (range = 19.5-59.9%, n = 8) than their normal siblings (Table 7). Similarly, dicephalics average 26.7%% shorter in length (range = 6.7-57.2%, n = 4) than their siblings (Table 8).

Table 5. Number of dicephalic snakes by geographic region and reliability type

Region	Total	1	2	3	4
North America	543	127	202	170	44
Europe	116	56	42	12	6
Asia	101	40	48	13	0
Latin America	82	45	33	3	1
Africa-Madagascar	41	17	18	5	1
Australia-Indonesia	32	10	16	6	0
Unknown	35	10	15	7	3
Total reports	950	304	374	216	55

If holodichotomy is disregarded and only the mutations are considered, 93% of somatodichotomous snakes fall into the cranio- or prodichotomous categories (hence the most common appellation of dicephalism as the majority of monsters have two heads). The exact dividing line between prodichotomous and proarchodichotomous snakes is unclear and one cannot separate some craniodichotomous and prodichotomous snakes without a radiograph. Thus the classification system needs refinement. The actual percentages for each category based on 505 cases are as follows: prodichotomy (61.4%), craniodichotomy (31.1%), amphidichotomy (3.4%), proarchodichotomy (1.4%), opisthodichotomy (1.4%), and urodichotomy (1.4%). Several modern authors have claimed that instances of two-tailed snakes are unknown (Barbour, 1926; Thomson, 1935) but this is untrue; urodichotomous vipers were reported to be seen from time to time by Aldrovandri as early as 1640.

Several types of twins are possible. Maternal or monozygotic twins are identical twins of the same sex sharing one umbilicus and egg yolk, resulting from the division of a single fertilized ovum (Braun, 1876; Lauria, 1960; Petch, 1990; Haagner, 1994). Fraternal or dizygotic twins are non-identical twins of either sex, each with its own umbilical cord and egg yolk, resulting from multiple fertilization by two zygotes (Vanzolini, 1947; Singh and Thapliyal, 1973; Fukada, 1978; Gudynas and Gambarotta, 1981; Crowe, 2000). In a bizarre case Marion and Nowak (1980) hatched a pair of *Pantherophis guttatus* twins with separate umbilical cords for 60% of their length that united to form a single umbilicus for 40% of its length that originated from a single yolk sac. Siamese twins are conjoined twins and may be either monozygotic or dizygotic (Tóth et al., 2005). Accidental twins occur when two separate ova or embryos become encapsulated within a single egg shell or membrane (Cunningham, 1927; Ross and Marzec, 1990). This most likely is what happened with the eggs of *Natrix natrix* (Braun, 1876) and *Coronella austriaca* (Cligny, 1897) that had two embryos, each with their own yolk mass. At least one case is known in which a clutch of eggs contained both a set of twins and a dicephalic (*Coluber constrictor*, Wallach, 1995). There are several puzzling situations, possibly accidental inclusions of a dicephalic with a normal embryo, seen in the cases of wild-collected *Coluber constrictor* (Brimley, 1903) and *Heterodon platirhinos* (Meyer, 1958) eggs that contained two embryos, one of which had two heads. Also, one supposed dicephalic hermaphrodite is known in *Coluber c. constrictor* in which the right half of the body is reported to be male, with an everted hemipenis, and the left half female (Dexter, 1976). This report is incredible and unfortunately cannot be verified as the specimen (MCZ 20183) is now missing or lost.

Table 6. Number of dicephalic cases in the USA by state and reliability type

State	Total	Type 1	Type 2	Type 3	Type 4
Alabama	6	2	2	2	0
Arizona	3	1	2	0	0
Arkansas	4	1	1	2	0
California	59	15	26	15	3
Florida	16	3	10	3	0
Georgia	19	2	1	14	2
Idaho	3	0	0	1	2
Illinois	13	3	3	7	0
Indiana	15	0	4	9	2
Iowa	9	0	4	4	1
Kansas	5	0	3	1	1
Kentucky	6	1	2	2	1
Louisiana	3	1	1	1	0
Maine	4	1	1	2	0
Maryland	10	4	3	3	0
Massachusetts	20	10	4	5	1
Michigan	7	2	1	3	1
Mississippi	3	2	0	1	0
Missouri	10	2	2	6	0
Montana	2	1	1	0	0
Nebraska	2	0	1	1	0
Nevada	3	0	1	2	0
New Hampshire	3	1	1	0	1
New Jersey	4	0	2	1	1
New Mexico	1	1	0	0	0
New York	29	2	13	10	4
North Carolina	16	5	8	2	1
North Dakota	0	0	0	0	0
Ohio	14	4	2	5	3
Oklahoma	5	0	3	2	0
Oregon	15	7	5	2	1
Pennsylvania	38	6	6	19	6
South Carolina	5	0	1	4	0
South Dakota	1	0	1	0	0
Tennessee	9	4	2	3	0
Texas	27	7	10	9	1
Utah	3	3	0	0	0
Virginia	11	5	2	3	1
Washington	5	0	2	3	0
West Virginia	7	0	2	4	1
Wisconsin	4	0	0	3	1
Unknown	112	30	66	11	5

Table 7. Comparison of length and weight of hatchling twins and embryos with normal siblings. e = embryo, *n* = number of eggs, s = snout-vent length

Species	*n*	LENGTH (mm) Twins	LENGTH (mm) Siblings (mean)	LENGTH (mm) Difference (%)	WEIGHT (gm) Twins	WEIGHT (gm) Siblings (mean)	WEIGHT (gm) Difference (%)	Reference
Chondropython viridis	17	—	—	—	5.1-5.3	11.0	51.8-53.6	Crowe, 2000
Python m. molurus	30	550-550	611	10.0	48.0-48.0	111.6	57.0	Manimozhi et al., 2006
Python regius	12	180-230	355	35.2-49.3	20.0-29.0	61.0	52.5-67.2	Gund, 2001
Coluber constrictor	3	206-218	266	18.0-22.6	—	—	—	Tuck, 1970
Coluber constrictor	18	226-233	309	24.6-26.9	—	—	—	Wallach, 1995
Diadophis punctatus	4	110-110	142	22.5	—	—	—	Groves, 1978
Elaphe bimaculata	3	111-111	140	20.7	—	—	—	Petch, 1990
Elaphe climacophora	4	340-342	445	23.1-23.6	9.8-10.2	19.7	48.2-50.3	Fukada, 1978
Opheodrys aestivus	6	141-151	198	24.7-29.8	—	—	—	Curtis, 1950
Pantherophis guttatus	18	222-245 s	288 s	14.9-22.9	3.05-4.10	6.38	35.7-52.2	Marion & Nowak, 1980
Pantherophis spiloides	9	250-255	311	18.0-19.6	—	—	—	Shuette, 1978
Philodryas patagoniensis	3	133-144	190	24.2-30.0	1.40-1.45	2.50	42.0-44.0	Gudynas & Gambarotta, 1981
Xenochrophis piscator	22 e	—	—	—	0.029-0.038	0.041	7.3-31.6	Singh & Thapliyal, 1973
Xenochrophis piscator	31	133-133	149	10.7	0.75-0.75	1.37	45.2	Singh & Thapliyal, 1973
Vipera berus	10	89	127	29.9	—	—	—	Leighton, 1901

Table 8. Comparison of length (mm) of hatchling and embryonic dicephalics with normal siblings. e = embryo, *n* = number of eggs

Species	*n*	Dicephalic	Siblings (mean)	Difference (%)	Reference
Coluber constrictor	18	263	309	14.9	Wallach, 1995
Heterodon platirhinos	3	80 e	187	57.2	Meyer, 1958
Pantherophis obsoletus	7	196	210	6.7	Wallach, 1995
Vipera berus	7	130	180	27.8	Lagerlund & Hanström, 1951

Twins of the lizard *Lacerta vivipara* have been produced experimentally in the laboratory by dividing the blastoderms at the end of cleavage, with a 50% success rate (Hubert, 1964). Twins cannot be easily documented in live-bearing snakes or wild populations although a significant difference in the size of two neonates from their sublings would be suggestive. From the meager data available it appears that the production rate of twins is nearly the same in wild and captive-bred populations. Braun (1876) found a twin production rate of 1:900 based on embryos of European colubrids taken from the wild and captive-bred ratios of 1:1000 in corn snakes (McEachern, 1991) and 1:1500 in king snakes (Ben Cole, pers. comm., 2002) are comparable.

The dicephalic mutation rate in captive-bred snakes seems to be approximately ten times higher than that estimated for wild populations. The mutation rate estimated from wild populations ranges from 1:20,000 (Klauber, 1956) for San Diego County snakes, 1:50,000 (E. R. Allen, 1956) for rattlesnakes, and 1:100,000 (Belluomini, 1959) for Brazilian snakes. These figures are comparable to the spontaneous mutation rate of 1:100,000 in mice and humans (Sachsse, 1983). In captivity the following figures are available from breeders: 1:175 in Australian pythons (Geoff Jacobs, pers. comm.), 1:300 in corn-snakes (Neil Gushulak, pers. comm.) and hognose snakes (Charles Wright, pers. comm.), 1:500 in colubrids (Berkeley Boone, pers. comm.), 1:600 in colubrids (Mark O'Shea, pers. comm.), 1:750 in colubrids (Ben Cole, pers. comm.), one in "thousands" (Lemke and Root, 1993; Rich Zuchowski, pers. comm.), and 1:10,000 in corn-, king- and rat-snakes (Kevin Bryant, pers. comm.).

There is a prevailing belief among captive snake breeders having experience with dicephalics that all examples are female and that the trait is perhaps sex-linked. While it is possible that sex-linkage is involved under certain conditions or in certain species, numerous males are known. In fact, based upon all available data from living snakes (as reported by their owners), dissected specimens, and embryos with or without everted hemipenes, males outnumber females. There are 44 male and 34 female snakes with somatodichotomy with one bisexual *Coluber constrictor* (Dexter, 1976) and two fraternal Siamese twins (*Vipera ursinii,* Tóth et al., 2005; *Thamnophis sirtalis,* Wallach, unpubl.).

The overwhelming majority of cases of axial bifurcation have the duplicated parts lateral to one another in the horizontal plane, that is on the left and right side. However, several examples are known of duplication in the vertical plane. Krysko et al. (2002) reported a *Nerodia clarkii* that had the heads opposite one another chin to chin. A pair of *Thamnophis sirtalis* Siamese twins also has the heads fused venter to venter (Wallach, unpubl.). Craniodichotomous snakes and prodichotomous snakes with short necks may have the opposing heads directed at any angle from being mobile and parallel to being firmly fixed at close to 180° so that the heads point in opposite directions as in *Boa constrictor* (Gaupp, 1990), *Philodryas olfersii* (Vizotto, 1975), and *Crotalus atrox* (Muir, 1990). The latter condition seems quite disturbing and would certainly be a challenge for the snake to move in any coordinated manner. An extremely minimal craniodichotomous condition is seen in *Pelamis platura* (Boettger, 1898) and *Natrix natrix* (Kincel, 1969) where only four nostrils are present but the rest of the head is normal. Raymond Ditmars had a *Crotalus horridus* born at the New York Zoo with heads bifurcating only to the orbital level so that only the two outer eyes existed (Cunningham, 1937). More extensive division of the skull often results in the two medial eyes fusing to form a three-eyed specimen as in *Morelia mcdowelli* (Hoser and Harris, 2005), *Coluber constrictor* (Mitchill, 1826), *Natrix natrix* (Silly, 1841), *Crotalus durissus* (Wiley, 1930), *Nerodia sipedon* (Cunningham, 1937), *Vipera aspis* (Payen, 1991), *Vipera ursinii* (Tóth

et al., 2005), and *Lampropeltis getula* (Wallach, unpubl. data).

Vertebrae

Based upon those snakes that have been x-rayed, the number of vertebrae in each neck varies from 1 to 77. Usually the left and right necks are equal in length with a similar or identical number of vertebrae but occasionally one neck is considerably longer than the other. The greatest difference in vertebral number recorded thus far is 20% in a *Thamnophis sirtalis* from Massachusetts with 30 vertebrae in its right neck and 24 in its left neck (Johnson, 1902). Following are data on the vertebral numbers in the left/right necks of some species as deduced from radiographs: 1/1 *(Philodryas olfersii)*, 2/2*(Lampropeltis getula)*, 4/4 (unidentified species), 5/6 *(Natrix natrix)*, 6/6 *(Coluber constrictor, Pituophis catenifer, Thamnophis elegans)*, 7/7 *(Nerodia fasciata, Vipera berus)*, 8/10 *(Natrix maura)*, 10/11 *(Thamnophis elegans)*, 11/13 (unidentified species), 12/12 *(Gloydius blomhoffii, Liophis poecilogyrus)*, 12/13 *(Thamnophis sirtalis)*, 13/13 *(Nerodia sipedon)*, 14/11 *(Nerodia rhombifer)*, 14/13 *(Pantherophis guttatus)*, 14/14 *(Agkistrodon piscivorus)*, 15/16 *(Natrix natrix, Thamnophis sirtalis)*,16/16 *(Elaphe conspicillata)*, 16/19 *(Leptotyphlops bicolor)*, 18/15 *(Pituophis c. catenifer)*, 19/19 *(Bothrops atrox)*, 20/20 *(Lampropeltis getula)*, 23/23 *(Crotalus durissus)*, 25/25 *(Zamenis longissimus)*, 26/26 *(Bothrops jararacussu)*, 26/27 *(Thamnophis elegans)*, 29/27 *(Lampropeltis getula)*, 29/30 *(Coluber constrictor)*, 31/29 *(Gloydius blomhoffii)*, 32/32 *(Hydrophis spiralis)*, 42/42 *(Gloydius blomhoffii)*, 57/66 *(Pituophis sayi)*, and 76/77 *(Epicrates cenchria)* (Johnson, 1902; Lönnberg, 1907; Strohl, 1925; Fisher, 1928; Heasman, 1933; Nakamura, 1938; Belluomini, 1965; Branch, 1979; Vanni, 1979; Wallach, unpubl. data).

Where the two separate vertebral columns unite there is a short transition region between the double necks and single spinal column that I propose to call the fusion zone. It is characterized by vertebrae that are compressed anteroposteriorly so that they are distinctly thinner in the anterior-posterior plane but are enlarged laterally so that they are thicker in the dextro-sinistral plane, almost as if the vertebrae had been compressed together with bone squeezing out to the sides. In the fusion zone the attached ribs are closer together than in the other regions. The fusion vertebrae in this zone may number 2 *(Bothrops atrox, B. jararacussu,* and *Crotalus durissus,* Belluomini, 1965; *Natrix maura,* Blanc, 1979), 3 *(Thamnophis elegans,* Wallach, unpubl.), 4 *(Platyceps florulentus,* Heasman, 1933), 5 *(Gloydius blomhoffii,* Nakamura, 1938; *Philodryas olfersii,* Vizotto, 1975), 6 *(Vipera berus,* Lönnberg, 1907), 8 *(Epicrates cenchria,* Wallach, unpubl.; *Euprepiophis conspicillatus,* Nakamura, 1938), or 11 *(Thamnophis elegans,* Wallach, unpubl.). Posterior to the fusion zone the vertebrae resume their normal size and shape for their position along the spine. In a craniodichotomous *Sibynomorphus mikanii* all the vertebrae are single but the first 8 vertebrae are thickened as in the fusion zone of dicephalics (Laporta et al., 1983). By definition craniodichotomous specimens have a single axis and atlas (Hyde, 1925) although a *Lampropeltis getula californiae* with the heads fused posteriorly is known with the atlas and axis paired and no fusion zone (Wallach, unpubl.). This illustrates the importance of having radiographs to correctly classify the condition.

The left and right heads of dicephalics may be symmetrical and equal in size or they may be asymmetrical and unequal in size. The majority of long-lived specimens are symmetrical with equally sized heads; presumably that condition reflects perfectly formed muscular, visceral, and neurological connections between the single and duplicated parts of the anatomy. One head may be larger than the other and more in line with the body axis (Mishra and Majupuria, 1979). In extreme cases the smaller head appears degenerate or incompletely formed as in the case of Raymond Ditmars' rattlesnake whose second head had the mouth sealed (Frauscher, 1903; Hyde, 1925), or even just a parasitic outgrowth (Fisher, 1868; Wilder, 1904), that is set off at a large angle to the body axis. Other cephalic deformities are known, one being two heads with only a single lower jaw (Isaac, 1982) and another a single head with two lower jaws (Wallach, unpubl.).

Internal Anatomy

Only a scattering of reports on the viscera of these snakes have been published. Several obstacles present themselves towards achieving this end. Nearly all of the specimens are small neonates; others are improperly preserved, shrivelled or dessicated; many have spinal deformities in addition to their dicephalism and are twisted or contorted with body sections often fused together (Riches, 1967; Rubin et al., 1967). All of these conditions make dissection difficult or impossible. Nonetheless, a few publications contain the results of examination of the internal organs of certain species. These include *Boa constrictor* (Cunha, 1968), *Cerberus rynchops* (Rayer, 1850), *Crotaphopeltis hotamboeia* (FitzSimons, 1932), *Echinanthera cyanopleura* (Lema,

1994), *Elaphe climacophora* (Nakamura, 1938; Sato, 1953; Niimi, 1965, 1971a-b; Payen, 1991), *Elaphe conspicillata* (Nakamura, 1938), *Homalopsis buccata* (Brongersma, 1952), *Lampropeltis getula* (Yarrow, 1878; Wallach, 1995), *Lampropeltis triangulum* (Orós et al., 1997), *Natrix natrix* (Redi, 1684); Vsevolojsky, 1812; Cantoni, 1921; Ladeiro, 1935; Themido, 1944; Naulleau, 1983), *Nerodia clarkii* (List, 1954), *Pantherophis spiloides* (Andreadis and Burghardt, 1993), *Platyceps florulentus* (Heasman, 1933), *Ptyas mucosus* (Brongersma, 1952), *Rhabdophis tigrinus* (Nakamura, 1938), *Sibynomorphus mikanii* (Laporta et al., 1983), *Thamnophis cf. ordinoides* (Nelson and Slavens, 1975), *Hemibungarus japonicus* (Nakamura, 1938), *Hydrophis spiralis* (Strohl (1925), *Bothrops alternatus* (Astort, 1981), *Crotalus adamanteus* (Murphy and Shadduck, 1978), *Crotalus atrox* (McAllister and Wallach, 2007), *Crotalus basiliscus* (Wiley, 1930), *Crotalus viridis* (Reid, 2005), *Daboia russelii* (Khaire and Khaire, 1984), *Gloydius blomhoffii* (Yoshinaga, 1901; Nakamura, 1938), and *Vipera berus* (Dutrochet, 1830; Dorner, 1873; Borgert, 1897).

Usually the anterior-most organs, such as the esophagus and trachea, are duplicated regardless of the extent of cervical duplication. Often there are two hearts and two sets of lungs, and even the stomach and liver may be duplicated. There is no correlation between the duplication of the spinal column and that of the viscera, an extreme example of this being the craniodichotomous *Crotalus atrox* that had two tracheae, tracheal lungs, right lungs, left and right thymus glands, hearts, anterior circulatory systems, livers, gall bladders, pancreas, spleens, esophagi, stomachs, and anterior small intestines (duodeni), which joined after 1/3 of their length into a single small intestine. The remaining viscera were single (McAllister and Wallach, 2007).

Causal Factors

A number of possible causes of somatodichotomy have been proposed, including 1) incomplete division of a single embryo, 2) partial fusion of two embryos, 3) abnormally low or high temperatures during incubation or gestation, 4) regeneration after an embryonic lesion, 5) anoxia during embryonic development, 6) toxic effect of metabolic secretions during a prolonged sojourn in the oviduct, 7) inbreeding depression from small population gene pools, back-crossing, designer morphs, and albinos, 8) hybridization, 9) environmental pollution, 10) chemical toxins in captivity, and 11) exposure to radiation. Examples attributed to all of these presumed factors are known. There is no evidence that vitamin deficiencies in parents result in dicephalic offspring (Jackson and Cooper, 1981). While it is well known that dicephalic vertebrates, mostly fish but including a lizard, have been experimentally produced in the laboratory by utilizing some of the factors listed above, there is only a second-hand report of a dicephalic snake being artificially produced in the Cincinnati Zoological Gardens (Abe, 1952). I have been unable to confirm this statement and would like to learn if it is true.

Incomplete division of a single embryo

The majority of craniodichotomous and prodichotomous specimens appear to be the result of a partial division of a single snake. In studying a wide variety of animals, including a *Storeria occipitomaculata*, Wilder (1908) considered dicephaly to occur in this manner.

Partial fusion of two embryos

A dicephalic *Vipera berus* from Germany was thought to be the result of incomplete fusion of two embryos (Dorner, 1873). Vanzolini (1947) suggested that a dicephalic *Crotalus durissus* from Brazil was the result of fusion of two embryos due to the differences in scalation of the heads and necks, areas of ventrals isolated among the dorsal scales, repeated twisting of the vertebral column, anterior extremities in different sagital planes, and the higher incidence of anterior level bifurcations since differentiation proceeds backwards. A pair of non-identical twin *Thamnophis sirtalis* (FMNH) is fused venter to venter, suggesting fusion rather than splitting (Wallach, unpubl.).

Abnormally low temperatures during incubation or gestation

One of the most commonly associated factors with the birth of dicephalic snakes is a cooler period during incubation/gestation. Cases resulting from known suboptimal incubation temperatures include *Elaphe schrencki* (Bakken and Bakken, 1987), *Natrix natrix* (Allen, 1990), *Bothrops moojeni* (Anrade and Abe, 1993), *Crotalus atrox* (Muir, 1990), and *C. viridis* (Pendlebury, 1976). Anomalies of head scalation and ventral scutes, vertebrae and ribs, and kinks in the body and fusions of parts are known to result from lowered temperature,

as reported in *Python molurus* (Vinegar, 1973), *Nerodia fasciata* (Osgood, 1978), *Pituophis sayi* (Gutzke and Packard, 1987), *Thamnophis elegans* (Fox, 1948; Fox et al., 1961), and *Thamnophis sirtalis* (Shine et al., 2005). Lourdais et al. (2004) found that *Vipera aspis* embryos were most sensitive to cool temperatures late in the gestation period.

Abnormally high temperatures during incubation or gestation

Conversely, elevated temperatures have also been implicated as a causative factor in cases of axial bifurcation. Specific examples include *Natrix natrix* (Riches, 1967), *Python molurus* (Vinegar, 1974), *Nerodia fasciata* (Osgood, 1978), *Lampropeltis getula* (Zweifel, 1980), *Pantherophis alleghaniensis* (Ball, 1995), *Morelia amethystina* (Heath Butler, pers. comm.), and *Pantherophis guttatus* (Sasheena Kurfman, pers. comm.). Gutzke and Packard (1987) found abnormalities in *Pituophis sayi* to be eight times as common at 32°C than at 27°C.

Regeneration after an embryonic lesion

Both Tornier (1901) and Thomson (1935) suggested that the dicephalic condition in snakes may result from an embryonic injury followed by regenerative growth.

Anoxia during embryonic development

Stockard (1921) demonstrated that anoxia, or a low oxygen supply, during the gestation period of fishes will result in the production of two-headed, double-bodied and twin individuals from a single egg.

Toxic effect of metabolic secretions

Heasman (1933), in studying *Platyceps florulentus,* indicated that a prolonged duration in the oviduct could result in a toxic effect from secretions, metabolic products, or the disintegration of other eggs. He also suggested ovarian exhaustion and delayed fertilization as possible causative factors. A pair of identical female conjoined twins was born to a *Pantherophis guttatus* that had a mouthrot infection at the time of gestation (Sasheena Kurfman, pers. comm.).

Inbreeding depression

Inbreeding depression in both plants and animals is the reduction of fitness that is normally manifested in characters relating to the reproductive or physiological capacity (Falconer and Mackay, 1989). Inbreeding increases homozygosity and the number of recessive genes (Lerner, 1954). Federsoni (1981) showed that inbreeding of 33 normal *Bothrops atrox* offspring with their wild-caught mother produced no abnormalities or stillborn young in the first generation (F1). After 6 months 18% of the neonates died. However, in the F2, F3, and F4 generations, after 6 months the death rate was 89%, 66%, and 73%, respectively. In the F2, F3, and F4 generations stillborns were 11%, 0%, and 20%, and abnormalities were 6%, 3%, and 27%, respectively. Inbreeding success, measured as percent of eggs hatched, in *Lampropeltis getula* was 70% with wild parents but only 43% with inbred siblings and half-siblings (Zweifel, 1980).

Examples of probable inbreeding depression resulting in dicephalous neonates are seen in the following cases. A dicephalic *Pantherophis guttatus* from a cross between albino and hypomelanistic parents was among 22 siblings that also included albinos, hypomelanistics, and anerythristics. Another dicephalic *Pantherophis guttatus* originated from the cross of two snow corn morphs (Alex Hue, pers. comm.). Two albino dicephalics have resulted from matings with a pair of albino parents: "Medusa III" was produced from two amelanistic albino *Pantherophis obsoletus* (Casey Lazik, pers. comm.) and "Hammerhead" originated from two albino *Crotalus atrox* (Muir, 1990). The mating of a pair of albino sibling *Lampropeltis getula californiae* produced a clutch of eight eggs; the four that hatched were two albinos and two normally pigmented, one of the latter being opisthodichotomous (Wallach, unpubl.). A pair of identical female conjoined twin *Pantherophis guttatus* born with their hearts outside the body were the progeny of a cross between a reverse Okeetee and striped heterozygous albino (Wallach, unpubl.). The 16 progeny from the cross of a cremesicle and snow *Pantherophis guttatus* were three snows and 13 cremsicles, one of which was a dicephalic (Tim Curran, pers. comm.). A dicephalic *Lichanura* was born from the mating of two 100% heterozygous Limburg albino *Lichanura trivirgata* (Tom Siegrist, in litt.).

Hybridization

Newman (1917) demonstrated in fishes that hybridization between two species resulted in double monsters. Examples of hybridization contributing to the production of somatodichotomous snakes are known. The cross of a *Lampropeltis alterna* with a *L. mexicana* produced an opisthodichotomous snake with a single head but double bodies and tails (Ball, 1995). The mating of a *Lystrophis pulcher* with a *L. mattogrosssensis* also produced a two-headed hatchling (Charles Wright, pers. comm.). The cross of a *Lamprophis lineatus* with a *L. fuliginosus* also resulted in two dicephalics and one set of twins in 2000 (Donny Herring, pers. comm.). A dicephalic *Lampropeltis* was the result of a cross between a *Lampropeltis mexicana thayeri* and a *L. mexicana thayeri x L. ruthveni* hybrid (James Brumley, in litt.). A dicephalic *Acanthophis wellsi* resulted from the mating of a normal mother with a hybrid *A. pyrrhus x A. wellsi* father (Maryan, 2001). Inbreeding success between hybrid subspecies of *Lampropeltis getula californiae* and *L. g. splendida* was only 36% (Zweifel, 1980).

Environmental pollution

Gray et al. (2001) discovered various developmental anomalies in *Thamnophis sirtalis* from an 80 acre hazardous waste site in Millcreek Township near Eire, Pennsylvania, that was used as a landfill from 1941-1981. Additional anomalies were seen in successive litters born to a captive *Thamnophis sirtalis* collected at the Millcreek site in 1997 (Gray et al., 2003). John Applegarth (pers. comm.) suspects that a rash of dicephalic snakes in Oregon in the 1980's and 1990's was the result of dioxin-contaminated herbicides used by forest managers.

Chemical toxins in captivity

Unpublished reports of dicephalism occurring after use of chemicals in captivity include *Lamprophis fuliginosus* with 'Mr. Clean' (Ben Cole, pers. comm.), *Pantherophis guttatus* with "Shell No-Pest Strips"(Sasheena Kurfman, pers. comm.), and *Thamnophis sirtalis* with 'Vapona Insecticide Strips' (Mark O'Shea, pers. comm.).

Radiation

It has long been known that ionizing radiation will case mutations. The spontaneous mutation rate in vertebrates is doubled with 30-60 roentgens of radiation, whereas the lethal dose is 800-1000 roentgens (Sachsse, 1983).

Birth and Longevity

Most cases of axial bifurcation, from what we know, occur singly within a clutch of eggs or brood of young snakes. However, several cases of multiple occurrence are known and quite often other anomalies, such as incomplete heads, deformities, kinked spines, and fused body sections accompany dicephalics. Mitchill (1826) reported on the first such case in which three abnormalities were present in a nest of 120 young *Coluber constrictor!* Most likely the count of young was in error or this was a nest of several mothers hatching nearly simultaneously; it will never be known whether the three monsters originated from different clutches or a single one. A craniodichotomous and prodichotomous pair of *Lamprophis fuliginosus* occurred in a clutch of 11 eggs (Haagner and Rhyn, 1991) and Neil Gushulak (pers. comm.) hatched a similar pair of *Pantherophis guttatus* from a clutch of 27 eggs. Vial (1968) reported a clutch of 17 eggs from a wild caught *Natrix maura* of which only three were normal and the other 14 monsters. He stated that the majority of the monsters were dicephalic! What is unclear from his article is how many of the deformed individuals were actually dicephalic as only two are specifically mentioned: a deformed single headed snake and a dicephalic with a fused body that is illustrated. If the author is taken literally, from 8-13 snakes were dicephalic, which would be quite extraordinary. It is unknown if these specimens were preserved; if so, their location remains a mystery. Leighton (1901) once found three sets of twins among a clutch of 7 eggs in *Vipera berus*.

The majority of dicephalic individuals are either stillborn or, if born alive, they survive only a few hours or days, even if they appear physically normal (Davies, 1974; Khaire & Khaire, 1984). Some neonates starve to death in captivity because they are disinclined to feed (Strecker, 1926; Guthrie, 1929; Nickerson, 1966;

Reid, 2005), physically unable to swallow prey due to a malformed mouth or missing esophagus, or cannot digest and assimilate food due to a blockage or malformation of the digestive tract (Broadley, 1975). Many oviparous snakes are unable to pip open their eggshell and drown before they can hatch (Riches, 1967; Haagner and Rhyn, 1991; Anon., 2005); often the breeder doesn't notice the egg is late in hatching until a day or two has passed and by then the embryo is dead (Hingley, 1991; Geoff Jacobs, pers. comm.). Sometimes even when the egg is pipped the snake will fail to emerge (Bakken and Bakken, 1987; Bechtel, 1995). Only a small percentage of snakes live to maturity (Curran and Kauffeld, 1937; Cowles, 1939): 3% based upon available data (however, the death date is unknown for the majority of captive specimens).

Collection of dicephalic snakes in nature is usually a fortuitous and unplanned event although Zachary Archer claimed that he caught a two-headed or two-tailed snake "about three times per year" (Anon., 1889a). Some people have had unusual experiences finding their two-headed snakes. For example, a dicephalic rattlesnake *(Crotalus)* was easily captured near Izora, Texas in 1901 when both heads attacked and were trying to swallow a jackrabbit (Anon., 1901). In a similar incident George Sloan, an Indiana farmer living on the knobs in Monroe County, caught an adult amphidichotomous *Pantherophis obsoletus* about 1200 mm long in his chicken coop. He had been missing newborn chicks and suspected rats to be the culprit so when he heard a ruckus in the coop on the morning of 18 October 1899 he entered it to find a large rat snake tusselling with a chicken. It had two heads and two tails, and each head had attacked the chicken from opposite ends, neither one letting go. After pinning the snake to the floor with a pitchfork, the snake was captured. It was taken to Jeffersonville for viewing (Anon., 1899). Mr. Yang found a dicephalic *Dinodon rufozonatum* inside a bag in his backyard garden in Zhenyang, China.

Very rarely is an adult dicephalic caught in the wild; nearly all examples are found shortly after birth although a few have survived for several months in the wild before being discovered in a dehydrated and emaciated condition (Applegarth, 1991b). While on a fishing trip in July 1890, Capt. Leo Heit killed a 1.5 m "moccasin" at the Cut Off below Galena, Illinois (Anon., 1890). Frank Keim reportedly killed a 1.3 m *Coluber constrictor* on the Pennsylvania Railroad tracks near Bloomsberg, Pennsylvania in 1908 (Anon., 1908). Another dicephalic "blacksnake" was reputed to be killed in an oats field on 28 August 1819 in Plymouth township, Ohio (Anon., 1819). Mr. Carrington reported that he observed the same two-headed snake over two consecutive summers (Anon., 1897). There is no voucher specimen or photograph for the three previous cases so they remain unproven. The fact is that virtually all dicephalic snakes surviving to adulthood are raised in captivity although there is one documented wild caught adult *Pantherophis obsoletus* (Calmonte, 1983). Table 9 lists dicephalic snakes that have survived for more than one year in captivity.

Those dicephalic adults growing to more than one meter in length are "Gertrude" and "Them"(1830 mm), "Medusa" (1525 mm), "I-M"(1490 mm), "We"(1220 mm), "Thelma & Louise"(1200 mm), "Double Trouble"(1070 mm), and "Reginald & Llewellyn"(1000 mm). There is an unverified report of a wild-caught 1830 mm snake with two heads supposedly discoverd in October 1879 by a Chinese laborer in Eureka, Nevada (Douglas, 1941). A dried and mounted, 1200 mm dicephalic *Crotalus* from Texas is on display at The Freakatorium (El Museo Loco) in Manhattan, New York but it is possibly a fake. Other fakes include photos of two- and three-headed snakes on the internet that were doctored in PhotoShop.

Behavior

Living dicephalics often have a dominant head behaviorally where only one head will feed, drink, tongue-flick, and direct the movement of the snake. On the other hand, sometimes one head is dominant but both heads will feed and drink (Yeomans, 1989), one head is dominant and both will drink water but neither will feed (Anon., 2003), or one head is dominant (doing all the feeding and leading when crawling) but both drink water (Quinn, 1974). However, both heads eat but only the left head drinks in a *Pantherophis spiloides* from Mississippi (Bennett, 2004; Karen Dierolf, pers. comm.). For 41 snakes in which dominance is known there that 18 that are solely right head-dominant (44%), 14 that are solely left head-dominant (34%), and another 9 (22%) that have a dominant head but both heads function in some manner (feeding, drinking, tongue-flicking, crawling): 5 (12%) are right/both dominant and 4 (10%) are left/both dominant (Wallach, unpubl.). Although the sample size is small,

"Byron" *(Crotaphopeltis hotamboeia)* has a dominant head that does all the feeding but both heads will drink water (Smith, 1996). Certain individuals will feed with both heads cooperatively, either simultaneously

Table 9. Longevity of dicephalic snakes surviving more than one year. An * indicates the snake is still alive at present (according to my latest information)

Species	Age	Name	Institution
Pituophis catenifer catenifer	22 years 2-4 months	Medusa I	Steinhart Aquarium, San Francisco
Pituophis catenifer annectens	21 years 1 month	Reginald & Llewellan	Los Angeles Zoo
Lampropeltis getula yumensis	16 years 3 months	Loren & Leroy	Arizona State University, Tempe
Pantherophis spiloides	16 years	Instinct-Mind	University of Tennessee, Knoxville
Pantherophis guttatus	16 years	Thelma & Louise	San Diego Zoo
Pituophis melanoleucus mugitus	11 years +	Gertrude	Russo's Pet Store, Newport Beach
*Lampropeltis getula californiae**	8 years +	Tom & Jerry	San Diego Zoo
*Pantherophis obsoletus**	8 years +	Medusa III	Fred Lally, West Fork, AR
Lampropeltis triangulum hondurensis	7 years 3 months	Eddy	Reptilandia, Grand Canary Islands
*Lampropeltis getula californiae**	7 years +	Zany & Brainy	Prehistoric Pets, Valencia
*Pantherophis obsoletus**	6 years 9 months	We	World Aquarium, St. Louis
Lampropeltis getula californiae	6 years 6 months	Dudley Duplex II	San Diego Zoo
Pituophis catenifer annectens	6 years +	?	Santa Barbara Mus. Nat. Hist.
Lampropeltis getula californiae	5 years 5 months	Nip & Tuck	San Diego Zoo
*Lampropeltis getula californiae**	5 years +	?	South Florida Reptile Exchange
Crotalus horridus	4 years 6 months	Double Trouble	Fred Lally, West Fork, AR
*Pantherophis obsoletus**	4 years +	Laverne & Shirley	Prehistoric Pets, Valencia
Nerodia sipedon	4 years +	Hatfield & McCoy	Miami Serpentarium
Lampropeltis getula californiae	3 years 7 months	Dudley Duplex I	San Diego Zoo
Pituophis sayi	3 years	?	Hoessel Herpetarium, St. Louis
Gloydius blomhoffii	2 years	?	Shinto Temple, Nigata, Japan
*Lampropeltis triangulum triangulum**	2 years 10 months	Brady & Belichick	Van Wallach, Cambridge

or alternatively (Yoshinaga, 1901; Mrsic, 1997), whereas others will constantly fight over a single food item (Hyde, 1925; FitzSimons, 1932; Burghardt, 1991). A dicephalic snake in the New York Zoo around 1900 never ate because every time one head tried to feed it was attacked by the other head, eventually causing the snake to die of starvation (Bridges, 1974). In a *Pantherophis obsoletus* named "Medusa III" the left head cooperated while feeding but the right head did not: when the dominant right head fed, the left head remained passive but when the left head fed the right head constantly tried to steal the mouse from the left head (Casey Lazik, pers. comm.). L. M. Klauber had a *Thamnophis elegans* that would drink with either head but only feed with one head (Cunningham, 1937). Left head-dominant snakes (Keasey, 1969; Anon., 1972; Calmonte, 1983; Sánchez-García and Martínez-Silvestre, 1999) and right head-dominant snakes (Vsevolojsky, 1812; Minobe, 1930; Nishimura, 1938; Nickerson, 1966; Davies, 1974; O'Shea, 1990; Brown, 1991; Reid, 2005) are known as well as examples with both heads equally active (Wallach, 2005). Detailed growth and feeding records, in addition to behavioral observations, have only been kept on several individuals: *Thamnophis sirtalis* (John Applegarth, 1991a-b), *Pantherophis spiloides* (Burghardt, 1991; Andreadis and Burghardt, 1993), and *Lampropeltis triangulum* (Wallach, 2005). In an apparent contradiction to typical cases of asymmetry, a Malagasy *Acrantophis dumerilii* is reported to be right head-dominant but the left head is larger than the right and in line with the body axis whereas the right head is smaller and depressed (Wijnen, 1999). The two heads may even exhibit different personalities as in the case of the *Vipera berus* from Stockholm, Sweden that had a gentle left head that tried to escape attention and a wicked right head that attacked quicly and fiercely when teased (Anon., 1948).

Observations of locomotion in dicephalic snakes reveals that their movements are often jerky and

erratic, as if each head is trying to crawl in a different direction (Yoshinaga, 1901). "Brady & Belichick" crawl in a smooth motion most of the time but when startled the snake will stop and both heads and necks will quiver spasmodically for a few seconds, after which normalcy returns and it follows one head. At certain times it is apparent that each head wants to crawl in an opposing direction, usually when one head is resting on top of the other but each snout is oriented differently, and then the heads engage in a similar quiverring routine (Wallach, unpubl.). A dicephalic *Vipera berus* continuously crawled around in a circle or spiral motion as if it had inner ear probems, which it might have had with a duplicate set (Thomson, 1935). "Brady & Belichick" has been observed on two occasions to effortlessly crawl backwards on the grass as rapidly as it crawls forwards; this apparently impossible manuever has not yet been caught on film (Wallach, unpubl.). This ability was once reported in an unidentified dicephalic snake from Spokane, Washington (Anon., 1919).

In some dicephalics the heads learn to cooperate, in others they partially cooperate, and in some they never cooperate at all. For example, although "Brady & Belichick" learned a number of cooperative behaviors there is one area where they continue to differ: when the right head is feeding, the left remains passive and allows the other to swallow its pinkie, but when the left head tries to feed, the right continuously crawls around the cage, dragging the other head backwards, which usually results in the loss of the pinkie. At times the left head has been given the pinkie six times before it can manage to swallow it. This clearly demonstrates the independence of the two brains (Wallach, 2006). Conversely, in the case of "Instinct & Mind" it did not matter which head struck at the offered mouse because the other head always fought the first for swallowing priviledges, often delaying deglutition from a few minutes to an hour or more. If the heads were aware that the food was going to the same stomach for the benefit of each, one head should have allowed the other to feed unmolested—but this was never the case (Burghardt, 1991).

An unusual feeding behavior in the *Pantherophis obsoletus* named "Medusa III" that demonstrates some feedback between the two independent brains was that when one head was swallowing a mouse the other head mimicked the action of the feeding head by performing swallowing motions even though its mouth was empty (Casey Lazik, pers. comm.). This is reminiscent of a behavior once observed after shedding in "Dudley Duplex I,"the San Diego Zoo *Lampropeltis getula,* where the left head yawned and was then followed by a yawn by the right head (Perkins, 1955).

Another example of independent brains is the long necked, rear-fanged *Psammophis* in the Port Elizabeth Snake Park that committed homicide-suicide as a result of feeding complications and jealousy! One day each head was given a frog to swallow and the snake was left alone but the next morning it was discovered that head A had swallowed head B down to the bifurcation of the necks, whereupon it couldn't proceed any further. Head B was still alive so it was freed by manipulation. After this event the two heads did not get along as well as previously. Head B apparently held a grudge against head A and eventually it attacked its neighbor and envenomated it so thoroughly that the snake died, a case of double homicide-suicide (FitzSimons, 1932). This is reminiscent of a case that occurred in Pennsylvania. H. C. Spencer, a Mount Lake farmer, captured a *Thamnophis* on 21 August 1910, which he put on exhibit at the Bradford County fair in Towanda. One of the snake's heads was vestigial with rudimentary eyes. The normal head evidently took exception to its stunted partner and eventually attacked the smaller head and chewed it and itself to death (Anon., 1910). Another snake, *Lampropeltis getula californiae,* is reported to have killed itself while fighting over a meal in the Santiago Zoo (Yeomans, 1989). A captive *Agkistrodon contortrix* owned by Zachary Archer of Storm King Mountain in New York's Hudson Highlands died when a rat, instead of a mouse, was offered as its weekly food. The vicious rat bit and killed one of the heads, whereupon the second head and the snake itself succombed and unfortunately died (Anon., 1888). This is reminiscent of the *Natrix natrix* studied by Francisco Redi (1684) in which the right head died seven hours before the left.

One advantage of having dicephalism was pointed out by John Garrett of Detroit in reference to the "water moccasin" he collected during a fishing trip to Kennett, Missouri; he said it was the only creature that had a decent chance of surviving Detroit traffic as it could look both ways at once! (Anon., 1946).

Value

Live dicephalic snakes have been increasing in value in recent years. A testimonial to their popularity is the fact that "Thelma & Louise," which cost a mere $3,500, got more publicity for the San Diego Zoo than a white tiger for which they paid $276,000 (Chapple, 1999). To any genuine snake-lover and conisseur of natural

wonders, a healthy, live two-headed snake is priceless and would not be sold for any amount of money (Fred Lally *in* Chapple, 1999; Geoff Jacobs *in* Gregory, 2005; Van Wallach *in* Kranich, 2006).

In the first documented sale of a dicephalic snake that I can find, the younger brother of Frank Hunt of Tarrant, Alabama sold Frank's pet two-headed "moccasin" in October 1935 without his permission for the sum of $3.00. Both Frank and his mother were upset as the reptile was estimated to be worth at least $50 (Anon., 1935). Since then living two-headed snakes have sold for the following amounts: $50 in 1980 *(Nerodia sipedon),* $750 in 2005 *(Lampropeltis getula californiae),* $850 in 1995 *(Crotalus horridus),* $2,500 in 1992 *(Pantherophis emoryi),* $3,000 in 1967 *(Thamnophis* sp.), $3,500 in 1991 *(Pantherophis guttatus),* $6,000 in 2000 *(Lampropeltis getula californiae),* $7,500 in 2006 *(Pantherophis guttatus),* $15,000 in 2006 *(Pantherophis obsoletus),* $20,000 in 2005 *(Lampropeltis mexicana* x *ruthveni),* and $25,000 in 2000 *(Pantherophis obsoletus).* In probably the most bizarre transaction of all, Harry Travera of Kalamazoo, Michigan traded a live horse to George Brewer of Augusta, Michigan for a hatchling *Sistrurus catenatus* in the fall of 1914 that unfortunately died after a couple months in captivity (Anon., 1915). Other asking prices for dicephalic snakes that were not met include $4,500 *(Nerodia sipedon),* $20,000 *(Pantherophis obsoletus),* $30,000 *(Pantherophis obsoletus),* $50,000 *(Lampropeltis getula californiae* and *Heterodon* sp.), and $100,000 *(Boa constrictor).* Offers for dicephalic snakes that were rejected include $2,500 for a *Pantherophis guttatus* ("Thelma & Louise"), $10,000 for a *Crotalus horridus* ("Double Trouble II"), and something less than $50,000 for a *Pantherophis obsoletus* ("We") (Chapple, 1999). The latter snake was put up for auction on eBay for $150,000 in 2006 but did not receive any bids (Holland, 2006). Dead, frozen, preserved, or dried somatodichotomous snakes have no value, other than as a curiosity, except to the scientific community. However, a preserved amphidichotmous *Python molurus bivittatus* was offered for auction on eBay in 2004 with a minimum bid of $4,500; although it represented a rare type of axial bifurcation, it is needless to say that there were no bids for the creature. The T. G. Johnson family of North Wilkesboro, North Carolina has kept a preserved two-headed snake in the family for 60 years (Anon., 1955).

Conclusions

I am interested in hearing from anyone who has had experience with dicephalic snakes, has any data or behavioral observations on them, or has any living or dead specimens that have not been documented in the scientific literature. Also, I am looking for news articles and photographs of dicephalic snakes, especially of unpublished specimens and I will purchase any dead or preserved specimens for study. My main interest is in cataloguing all known specimens (dead or alive) and secondarily in studying their viscera. Please contact me if you have any information on somatodichotomous snakes, even if it is anecdotal in nature.

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Addendum:

An exciting discovery of a dicephalic fossil reptile was published online in December 2006 by E. Buffetaut, J. Li, H. Tong and H. Zhang [A two-headed reptile from the Cretaceous of China, Biol. Lett. (2007), 3: 80-81]. This lepidosaur *(Hyphalosaurus lingyuanensis)* is approximately 121-127 million years old (lower Yixian formation, Early Cretaceous of Liaoning Province, China). It is an embryo or neonate with nearly complete duplication of each neck (at least 16 of the 19 cervical vertebrae are duplicated; body has 16-17 trunk vertebrae and tail has 55 caudal vertebrae). The fusion zone is not discernible but the neck duplication is at least 85%, possibly 100%. This evidence demonstrates the natural occurrence of axial bifurcation in reptiles millions of years ago."

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Errata:

Harris in recent issue of the Bull. MD Herp. Soc. (43)1:11, 2007, refers to the Black Rat Snake as *Pantherophis o. obsoletus* incorrectly. The name obsoletus correctly refers to the Western Rat Snake not the Eastern Rat Snake (=Black Rat Snake). The Eastern Rat Snake (=Black Rat Snake) is currently recognized as *Pantherophis alleghaniensis* while the Western Rat Snake is *Pantherophis obsoletus*. I apologize for any confusion this may have caused.

Herbert S. Harris, Jr., Ed

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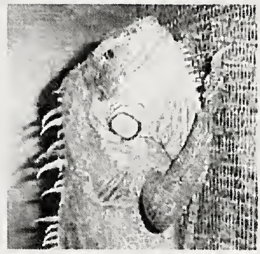

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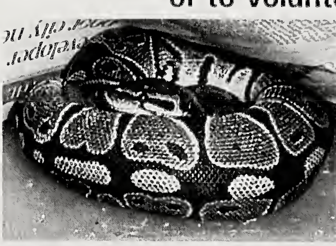

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DEPARTMENT OF HERPETOLOGY

THE NATURAL HISTORY SOCIETY OF MARYLAND, INC.

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DECEMBER 2007

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Membership Rates

Membership in the Maryland Herpetological Society is $25.00 per year and includes the Bulletin of the Maryland Herpetological Society. Foreign is $35.00 per year. Make all checks payable to the Natural History Society of Maryland, Inc.

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Meetings are held monthly and will be announced in the "Maryland Herpetological Society" newsletter and on the website, www.marylandnature.org.

Editors Note:

I apologize to our readers for consuming almost an entire issue of the Bulletin of the Maryland Herpetological Society to deal with a local problem with the State of Maryland's Department of Natural Resources....a problem that should have never occurred in the first place. In June of 2006, I became aware of a program already under way by DNR to release Pine Snakes (*Pituophis m. melanoleucus*) on Maryland's Lower Eastern Shore under the guise of "Reintroducing" an extirpated species. The problem was, they would be introducing a non-native species as the scientific data and content of the papers in this issue show.

I contacted the Associate Director, Glenn Therres, via e-mail, immediately upon learning of this program. I also sent copies, containing the known scientific data on the flawed program they were about to undertake, to others within DNR. About a month went by and I received a general e-mail announcing a public comment session to be held at Towson State University. Glenn Therres decided to hold this comment session at Towson State University where attendees were presented only the State's views of their program. Those present were then asked to vote and reach a decision based on the one-sided presentations. Talk about the scientific method! Those opposed to the program were not allowed to ask questions of the speakers, nor were any of us ever given the opportunity to explain our position to those in attendance. The audience was composed mostly of Towson State students. The local scientific community assembled a Position Paper, which I had, e-mailed to Glenn and others at DNR prior to the Towson meeting. At the meeting the vote of informed individuals indicated that the State had lost in its biased attempt to influence the audience. We later heard via different individuals that this "program", based on the results of the Towson meeting, and not on scientific evidence, was on permanent hold. At DNR's State Grant review, there was enough doubt in the minds of the reviewers, that this program came in next to last, assuring there would be no funding this coming year.

We thought that was that, although we never officially heard anything from Glenn Therres or anyone at DNR. To our surprise, in September, we learned that DNR was adding the Pine Snake to Maryland's list of Native Species in their new Proposed Permit Regulations. In the comment period we tried again to explain the error of their logic, and what the scientific data showed and indicated. DNR had found and used old accounts from the early 1900's that stated pine snakes ranged throughout Maryland, and that was "good enough for them". Based on private conversations and questioning from others the discredited specimen reportedly taken near Centerville, Queen Anne's County was used by DNR as the evidence of former occurrence. All subsequent research papers were disregarded. At the Towson meeting, we even got a statement from one of their constituents in the audience that if Pine Snakes occurred in the Southeast and in New Jersey they had to be in Maryland because "Pine Snakes can't fly". As of this date we have not been informed by Maryland's Department of Natural Resources regarding the status of the proposed release or the proposed regulations that would proclaim the Pine Snake to be a native species. As a matter of fact, we have not had any response to our e-mails, letters, the Position Paper, or public comments we submitted!

Maryland DNR has a slogan "Inspired by Nature, guided by science". Apparently, however, they have no understanding of scientific method. The complex concepts of biogeography are not understood by the State's administrators or even their biologists. I would like to extend my sincere thanks to the members of the scientific community who came together in a time of need and worked hard and tirelessly to try and help to resolve this issue and get Maryland's DNR more intuned with the local scientific community.

Herbert S. Harris, Jr.
29 October 2007.

DELUSIONS OF SCIENCE: CONCERNS REGARDING THE UNWARRANTED INTRODUCTION OF PINE SNAKES TO THE DELMARVA PENINSULA OF MARYLAND

In the summer of 2006 the Maryland Department of Natural Resources issued a press release about a proposed plan to "reintroduce" Northern pine snakes, *Pituophis melanoleucus melanoleucus*, into the Maryland portion of the lower Delmarva Peninsula. Following this press release, various local newspapers ran the story. As best we can tell, this program is expected to start in 2007. It is unclear why the state of Maryland did not issue a formal review and the opportunity for public input prior to starting this program. The proposal could have benefited considerably from review of outside experts.

We are concerned that this action will set a precedent that will encourage wildlife managers to attempt introductions of exotic wildlife species to areas where there is little or no evidence that they were established there within historical times. The evidence of natural pine snake occurrence in the Delmarva is problematic since there has been no acceptable documentation that this species occurs on the Atlantic coastal plain between southern New Jersey and southeastern North Carolina. One of the more intriguing aspects of zoogeography is the absence of many species from areas where they are expected to occur. This is a natural phenomenon and not an issue that needs to be corrected by wildlife managers. In the eastern United States, the modern distributions of fauna and flora are well known.

Disruptions in distributions are common. In some cases, these breaks may be of recent origin, but often they reflect paleo-environmental factors. Depending on the length of the time of isolation, these separated populations may development genetic signatures that reflect this aspect of their distribution.

Prior to our current understanding of the distributions of native animals, authors of various texts delineated the distributions of species by stating extreme distributional limits and implied that the organisms in question also occurred at all places in between. In fact this works for most species. It was not until the middle of the previous century that enough distributional records had accumulated to show that for some species there were natural geographic gaps in their overall range. Superficial evidence for occurrence of pine snakes in the Delmarva includes spurious statements in the early literature. These early authors described the Atlantic coastal state range of the pine snake as extending from New Jersey south to peninsular Florida (e.g., Cope 1875, 1900, Stejneger and Barbour 1933, 1939, Stull 1940, Wright and Wright 1957). There is an early publication about pine snakes in New York State that reports "These snakes are common in the more southern states of Delaware and Maryland where they grow very large." (Wallace 1902). We do not know the basis for this statement but we should point out that credibility is lost, as the snake does not occur in New York either. Incorrect assumptions regarding various aspects of the biology of other species are found in many of these early publications. This is to be expected. As our knowledge advanced, earlier misinformation was corrected. One of the key reasons for scientific publication is to expand our knowledge and to provide new information. Subsequently the eastern range of the pine snake has been further defined and the hiatus in its distribution is now well documented (Conant 1957, Conant 1958, 1975, Conant and Collins 1991, 1998, Linzey and Clifford 1987, Mitchell 1994, Palmer and Braswell 1995). For example, Ernst and Ernst (2003) state the range of pine snakes extends from New Jersey to Florida but in their distributional map they indicate its absence from the Delmarva and other Atlantic coast areas. Other works use commas or semi-colons to indicate a discontinuous range "Southern New Jersey, coastal plain of southern North Carolina..." (Ernst and

Barbour 1989, Behler and King 1979). This well documented hiatus extends from the Delaware Bay south to southeastern North Carolina. Another disjunct population of these snakes occurs in western Virginia. Sweet and Parker (1990) note that records for Arkansas, Maryland, New York and Veracruz probably represent introductions and were not included on their distribution map. Figure 1 provides a map of the distribution of the pine snake as it is currently documented (from Ernst and Ernst, 2003).

There are a number of specific treatments of Maryland and Delmarva herpetofaunas that exclude pine snakes from the faunal lists and/or state that earlier works suggesting that these snakes occurred on the Delmarva are erroneous or do not provide convincing evidence. These references span a period of six decades and continue to the present time (Cooper 1960, 1965, Cooper et al. 1973, Conant 1945, 1946, 1947, 1958, 1993, Groves and Harris 1967, Harris 1969, 1975, White and White 2002).

Information suggesting that pine snakes live or once lived in Maryland is limited to six or so reports of possible occurrence. Kelly et al. (1936) report a pine snake "taken near Centerville,

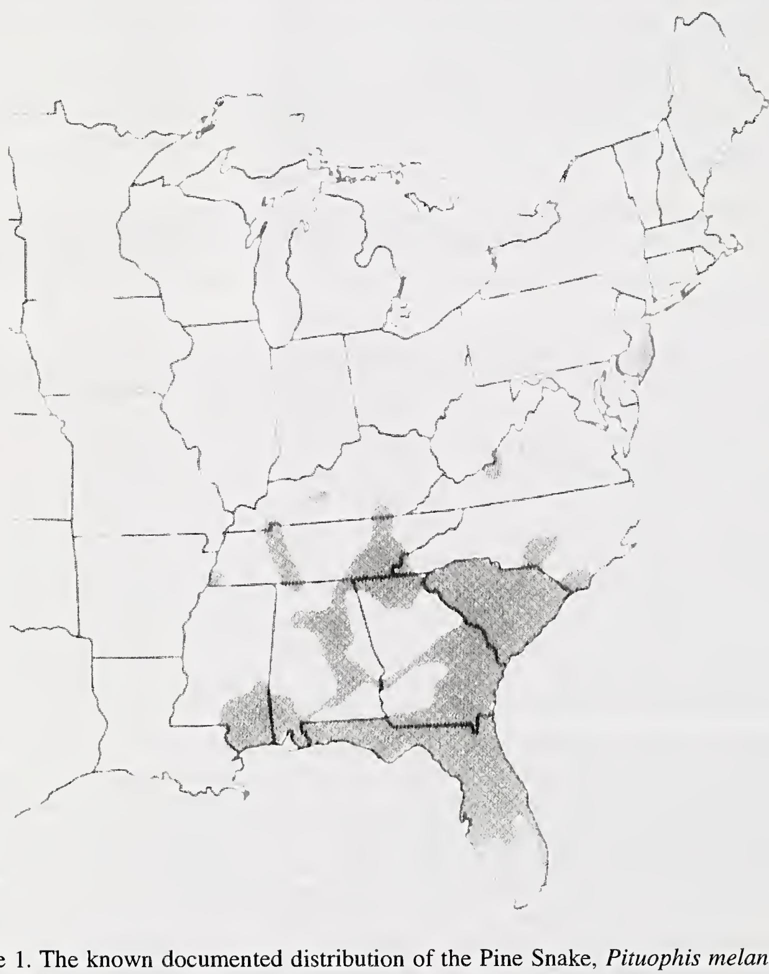

Figure 1. The known documented distribution of the Pine Snake, *Pituophis melanoleucus*, from Ernst and Ernst (2003).

Queen Anne County, in August, 1930..." Elsewhere in this publication another report is noted for Worcester County. McCauley (1945) discusses the same reports stating that the second one was found 0.75 mi from Snow Hill, Worcester County, near the Pocomoke River, but he rejects the Centerville sighting. One additional report is also presented by McCauley. In this same publication he mentions a pine snake from the Isle of Wight, near Bishopville, Worcester County. A fourth report is from Assateague Island, Worcester County (Lee 1972). An individual was collected from Fort Meade, Anne Arundel County in 1970 and in this same publication the author discusses pine snakes seen by a park ranger at Shad Landing State Park, Worcester County (Grogan 1973). A report in an unpublished 2006 DNR document is also available from a trailer park at Wayson's Corner, Anne Arundel County. Thus, two of the six-seven Maryland reports are from the western side of the Chesapeake Bay and four-five are from the Maryland portion of the Delmarva. Additionally, Grogan and Heckscher (2001) report on a specimen from a residential back yard in Dover, Kent County, Delaware and mention several sightings in Sussex County, Delaware. This provides a total of six-seven individual reports published over a period of 70 years for the Delmarva Peninsula. All these accounts were rejected by subsequent authors; all are of a second-hand nature, and none can be verified. Excluding the Dover record, no specimens or photographs currently exist for the Delmarva, and none of the snakes discussed were personally collected or seen by the authors reporting them. Even the recent publications of Lee (1972) Grogan and Heckscher (2001) express doubt regarding natural occurrence. They provide a very balanced and guarded review of the available information, make no definitive stand regarding the reports, and conclude by saying that additional field inventories would be needed before the species' status could be determined. Maryland DNR did conduct trapping surveys in what they considered to be prime habitat. No pine snakes were found, but then they decided to proceed with the "reintroduction" program. It is difficult to believe that anyone could emphatically believe that these reports, scattered in time and over a number of geographic locations, actually document natural relict populations.

We recognize that it is often difficult to correct erroneous information once it is in print and sometimes it again resurfaces decades after it has been corrected. Well-intended people keep rediscovering older and out of date publications. However, this is not the case here, and the people promoting the "reintroduction" should be aware that these pine snake reports have been carefully reviewed and dismissed by the herpetological community. Like the majority of the authors before us, we believe that the supporting evidence is scant and does not unquestionably demonstrate former occurrence of the pine snake on the Delmarva. Reasons for this are as follows:

a. Former fieldwork in the early and mid 1900s failed to confirm the presence of these snakes. This field activity was quite extensive and continued through the 1970s. Of particular significance was the effort of Roger Conant who spent a good portion of his career working on the Delmarva Peninsula (Conant 1945, 1947, 1958, 1993; Harris 2007a).

b. All reports are second-hand, and the three where actual specimens were seen by knowledgeable herpetologists were each of snakes found by others. At this time only one Delmarva specimen is extant (Dover, and it is clearly suspect since it was not found anywhere near anything resembling pine snake habitat; Grogan and Heckscher 2001), so the possibility of misidentification remains possible for the majority of the reports. These reports for the most part fail to provide adequate descriptions, and several do not even mention size.

c. The locations and years given for several of the reports strongly suggested the snakes encountered were escaped or released captives (Fort Meade, Anne Arundel County, Maryland, 1973; Dover, Kent County, Delaware, residential back yard, 1997; Wayson's Corner, Anne Arundel County, Maryland, backyard on the periphery of a trailer park 2006) and escaped or released snakes cannot be ruled out for many of the other reports. The association of the report with a military installation

(Ft. Meade) suggests the possibility of a snake acquired while personnel were assigned elsewhere, one that either escaped or was released when the pet's owner was later deployed (Cooper et al. 1973, Harris (1975).

d. While several accounts mention pine forest, these forests are of Virginia and Loblolly pines (*Pinus virginiana* and *P. taeda*). The Virginia pines reflect second or third growth woodlands on agriculturally depleted soils and thereby are not natural habitats. In southeastern North Carolina pine snakes are residents of long-leaf pine forest, *P. palustris*. This is a pine that does not grow naturally on the Delmarva. In New Jersey the pines of the Pine Barrens are primarily pitch pines, *P. rigida*. Pitch pines are not a natural component of the forests of the southern Delmarva (Little 1971) where the pine snake release is to take place. The natural pine forests here are loblolly, and elsewhere in the snake's native coastal plain range this is a forest type in which pine snakes are not known to occur. Along the sand ridges where the proposed release is to occur, the pines are short-leaf pines, *P. echinata*, another species that is not a major ecological associate of pine snakes. Grogan and Heckscher (2001) also discuss the distribution of these pines in relation to the occurrence of pine snakes, but in addition to the actual geographic distribution of the individual pines, one needs to consider forest type and the dominance of particular pines in the different regions.

e. The pine snake has a very complex distribution, perhaps one with more disjunct populations than any other reptile species occurring in eastern North America. The New Jersey to southeastern North Carolina hiatus is perhaps as large as the remainder of its total East Coast distribution. There is no reason to assume that, like the other gaps in the species' range, this Atlantic coast one is not natural. Fossils add little insight. The record for *Pituophis* fossils in the eastern United States, except for Florida, is meager, with isolated occurrences in caves in Georgia, Pennsylvania, and Tennessee (Holman 1995). The Pennsylvania record is based on fossils from New Paris Sink in Bedford County in the western part of the state. If anything, this would imply that the New Jersey pine snake population may have originated from an eastward expansion of western populations from the Mississippi valley, rather than connections with the southeastern Atlantic coastal plain.

f. A natural hiatus in this snakes' distribution is in part closely mirrored by the distributions of a number of other plants (i.e., thread-leaf sundew, *Drosera filiformis*) and animals (i.e., pine barrens treefrog, *Hyla andersoni*) that are absent from this area.

g. From a zoogeographic perspective there are a number of plants and animals of southern origin that reach distributional limits in the Chesapeake Bays area. A significant number of these are found no farther north than the Dismal Swamp region of North Carolina and Virginia. Some only occur to the east or west of the Bay, while others are found on both the eastern and western sides. These distributions were apparently established during the Pleistocene and continued up through the period when the Bay was formed (ca. 15,000 YBP). A redistribution of faunal elements in the Bay area, based on the way we think things should be, has no merit and certainly has no scientific basis. The zoogeography of the Bay region is complex and interesting, and one important aspect of this is the large number of species one would expect to be established in additional areas of the Bay region that fail to occur there.

h. Many of the pine snake reports from the Delmarva region were made during a period when science was still defining the distributional limits of species, and most were made prior to the availability of field guides and similar identification aids. All the identifications that are not specimen-based were from people with no proven herpetological expertise.

i. There are also legal considerations. In order to implement this program DNR will need to violate its own regulations prohibiting the release of captive animals into the wild. What would

the legal consequences be if these introduced snakes preyed on state-listed species of conservation concern, or on species that may be listed in the future? If the release experiment works, would these snakes expand into the other states on the Delmarva, and could some of their rare or endangered fauna become a prey source? Additionally one must consider federally listed species. Pine snakes are known to eat squirrels and ground nesting birds. Would predation on endangered Delmarva fox squirrels or piping plovers be considered take if they were eaten by an introduced species? While this seems a stretch of concern, these snakes are known to eat red squirrels and one of the distributional undocumented reports discusses snakes swimming to barrier island bird nesting colonies. Who would be responsible for the loss of endangered species eaten by an introduced snake?

j. The program as proposed does not take into consideration key factors recommended in similar management programs that include the release of snakes into the wild as a conservation tool. Himes, et al. (2006) describe their repatriation efforts for the Louisiana pine snake (*Pituophis ruthveni*) and discuss aspects of their program that need to be addressed for successful reintroduction. These include habitat management for a food source for the snakes, released animals should only be established into their natural range and habitat, and only snakes from the original gene pool should be used to prevent out breeding depression. None of these concerns are mentioned by Smith (2006).

While no one is considering that the two Anne Arundel County reports are of natural occurrence their presence supports the fact that pet snakes do escape or are released and can survive in the region and later find their way into the record. These snakes represent two-thirds of the existing specimens (Table 1).

The information provided to the press by DNR is very slanted and gives no indication that the original occurrence of these snakes in Maryland has always been in question. Phrases such as “reintroduce into historical habitat,” “This is one of the largest snakes in Maryland,” “not found in Maryland since 1972,” “where they have not been seen for 34 years,” and we are “not sure if they are still here or not,” gives the public the impression that the possibility of former absence of this snake from Maryland is not even an issue. The key fact that the snake’s natural occurrence is at best suspect is not even brought forth. The news articles even go so far as to explain the reasons for the snake’s decline, despite the lack of good evidence that it ever existed on the Delmarva. The fact that essentially the same information appeared in the three news releases we saw indicates that these accounts are not based on misinterpretation of individual reporters but were written from information provided directly by DNR. This is also confirmed by the quotes given by staff involved in the project. The information provided to the media appears to be carefully crafted to give the illusion of this being a science based conservation effort.

The state’s formal proposal (Smith 2006) to “reintroduce” this snake is apparently simply an in-house document and not something that was formally reviewed. To people who have not actually read the primary literature the argument to “reintroduce” pine snakes to the Delmarva would appear to be a noble conservation effort. The problem centers on the use of the term “reintroduced.” The most telling aspect of the proposal is that while nearly every source that mentions the occurrence or possible occurrence of pine snakes in Maryland is cited, not once is it mentioned that every subsequent publication individually or collectively questions the validity, ignores, or outright rejects these published reports.

The most amazing part of the proposal is the attempt to justify the “reintroduction” of pine snakes to the Delmarva by including another species of snake of questionable occurrence as evidence for pine snakes also formerly living here. After citing Mitchell (1994), a distribution map in a National Geographic article is referred to, which indicates that timber rattlesnakes (*Crotalus*

Table 1: Summary of pine snake reports from Maryland and Delaware 1930-2006.

Location	Date	Source	Second hand	Specimen	Status
MD: Queen Anne Centerville	Aug 1930	Kelly, et yes al. 1937	yes	lost	Rejected Co. nr. (1,2,3,4,5,6,7)
MD: Worcester Co. Snow Hill	1924	Kelly et al. 1937, McCauley 1945	yes	no	Rejected (2,3,4,5,6,7,9)
MD; Worcester Co, Isle of Wight	Sept 1936	McCauley 1945	yes	no	Rejected (2,3,4,5,6,7,9)
MD: Worcester Co. Assateague Is.	Spring 1969	Lee 1972	yes (based on sketch)	no	Rejected (7,8.9)
MD: Worcester Co. Shad Landing	?	Grogan 1973	yes	no	Rejected (5.7)
MD: Anne Arundle Co. Ft. Meade	Aug 1970	Grogan 1973	yes	yes	Rejected (5,7)
MD: Anne Arundle Co. Wayson's Corner	2006	DNR, unpublished	**yes**	**yes**	Rejected (9)
DE: Kent Co. Dover	1997	Grogan and Hechscher 2001	yes	yes	Rejected (9, 10)
DE: Sussex Co. Hechscher 2001	1966, 1993	Grogon and	yes	no	Rejected (9)

1. McCauley (1945)
2. Cooper (1960)
3. Harris (Cooper,1965)
4. Groves and Harris (1967)
5. Cooper et al. (1973)
6. Harris (1969)
7. Harris (1975)
8. Lee (1972)
9. Ashton et al. (2007)
10. Grogan and Hechscher (2001)

horridus) also once occurred on the Delmarva. The thinking being that on the Atlantic Coastal Plain the rattlesnake, like the pine snake, is also found to the south (North Carolina) and in New Jersey, and that this somehow validates the concept of the "reintroduction." The citation of Mitchell (1994) is telling in that the author of the proposal totally ignores the fact that Mitchell states "There is no evidence that *C. horridus* ever occurred on the Eastern Shore." The proposal refers indirectly only to the second-hand sight reports from the 1800s and early 1900s that Mitchell cites and dismisses. This is the same pattern that appears in justifying the pine snake "reintroduction." namely hearsay evidence that is cited as gospel while the opposing opinions of recognized herpetologists familiar with the Delmarva are omitted. See Harris (2007b) for both the recent and historic range of the timber rattlesnake.

Other factors of concern are that the introduction of these snakes could later mask discovery of a native population in the future, though for reasons outlined here this seems very unlikely. It is not clear how the state would legally deal with an introduced "endangered" or even protected species. In New Jersey there is currently a major issue with property development that has been prohibited by state endangered pine snakes (3 Dec 2006, Asbury Park Press, Toms River Bureau). In that nearly all of the Maryland and Delaware reports for the last four or five decades have come from developed landscapes, would not land planners and developers be able to argue that the interface between undeveloped lands and urban settings is now preferred habitat for pine snakes? If the state recognized these reports as ones of valid natural occurrence could not future development interests claim that they were actually enhancing the habitats for these snakes?

If the Maryland program is to proceed the introduced stock should probably be considered as an "experimental release" to avoid the potential of future legal conflicts.

The term "reintroduction" should be dropped from any description of the program for accuracy. Along similar lines most of the "records" referred to by DNR are actually only "reports" and biologists recognize that these words cannot be used interchangeably. Along similar lines various authors have referred to reports using the term "specimen" even though no individuals were retained, photographed, or preserved.

Additionally, one would hope that because both Virginia and Delaware share the peninsula, their agencies and state herpetologists would have been consulted prior to proceeding with the project.

There are probably reasons why this species is naturally absent from a significant portion of the Atlantic coastal states. These reasons may not be obvious as they may hinge on past Pleistocene events or other factors not apparent in the modern period. For example, in southeastern North Carolina pine snakes are found in a small area near the coast and then again to the west in the state's Sandhills region. They are totally absent from the intervening areas despite sandy upland soils and extensive stands of long-leaf pines. Additionally, the Delmarva soil types may not be compatible for pine snakes. While there are areas of dry sandy soils in the southern Delmarva, for the most part they are quite different from those in New Jersey or North Carolina. The soils that are identical to the ones in NJ where pine snakes occur are limited and linear in distribution. This is suggested by the differences in agriculture in these areas. For example, blueberry farms are common in both southeastern North Carolina and in southern New Jersey but are all but absent from the Delmarva. The primary pine communities that these snakes occupy in the east are absent from the Delmarva, and the food base there may not be able to support a six-foot snake. In North Carolina one of the major food items is the cotton rat, *Sigmodon hispidus*. This rodent is absent from the Delmarva. For the 12 species of reported prey items listed by Ernst and Ernst (2003), half of them are totally absent from the Delmarva.

We agree that publication of even questionable extra-limital reports is a valuable exercise for a number of reasons, not the least of which is showing distributional patterns over time. They may provide supplemental information when, and if, occurrence of a species is later verified. In fact, such reports often lead to the subsequent discovery and documentation of relict populations. Because of this we encourage authors and editors to continue to publish reports of out-of-range occurrences even when the substantiating evidence is less than complete. In this case while most modern day authors have not addressed the published pine snake reports for the Delmarva Peninsula they were clearly aware of them and chose simply to ignore them when writing species accounts. This is common practice for localities of questionable occurrence. We fail to understand why Maryland DNR does not recognize this and is continuing to use the older reports as supportive evidence for their program.

Maryland DNR has focused on the idea that the early reports are somehow more authoritative than recent attempts to characterize the status of pine snakes in Maryland. To some degree this is logical in that these reports were written at a point closer in time to what some believe to be a period during which these snakes were still present in the region. Therefore, the following may be of interest. As early as 1917, E. R. Dunn noted that records of pine snakes outside of Florida and New Jersey are few and far between (Dunn 1917). He then goes on to list a few records from North Carolina, Tennessee, and Bath County, Virginia. Thus, it would appear that the suggestion of a major hiatus in the pine snakes range was already suspected by the early 1900s.

We totally support the concept of reintroduction for extirpated species and depleted populations that were unquestionably a component of the native biota of a region or political unit. However, based on what is currently known the release of pine snakes in Maryland appears to be unwise. It distracts from real conservation issues and is an expenditure of time and resources that, by the agency's own admission, are in short supply. This appears to be more of a public relations program than anything that relates to science or conservation. This thought is supported by a promotional program regarding the release of pine snakes on the Delmarva that can be found on line. The fact that the state did not make the effort to discuss this program with much of the local herpetological community, particularly individuals and organizations with long-term experience in the region, or to consult those with libraries containing historical literature prior to proceeding with this program, is disappointing.

We fear that the flawed logic of this release could set a precedent for attempts to establish other species outside their native ranges, not just in Maryland but other states as well. This was done widely throughout North America for game fishes in the late 1800s and 1900s and our aquatic freshwater communities are still paying the price for these ill-advised programs.

It is worth pointing out that this is the same state agency that that for years has fought the concept of head-starting diamondback terrapins, *Malaclemys terrapin*, to supplement the Chesapeake Bay's over stressed, over exploited terrapin population. The pine snake introduction is also sponsored by the same division of this agency that sat idle while the last extant population of state endangered tiger salamanders, *Ambystoma tigrinum*, disappeared from lands that were purchased by the Nature Conservancy and given to the state for the salamander's protection (Lee 2006). Why is this agency disinterested in protecting its native fauna, yet has the resources to expand its program to species of questionable occurrence? All too often agencies are reluctant to enter into proactive conservation programs because they fear that there is not enough scientific evidence to justify a program or to suggest that it will succeed. The paradox is that here we have a situation where the scientific evidence is lacking and the scientific community has not supported the idea that the snake is native or that the program is warranted yet the agency proceeds with its planned activities.

It is difficult to understand when our agencies continue to remain unaware of the published contributions of professional biologists, but in this case statements in any number of key publications were deliberately ignored. We question the authority for an agency primarily concerned with regulatory responsibilities to be independently making and proceeding with decisions of this type. Keep in mind that this program is from an agency that stresses "every thing we do is based on the best available science."

In that the state has expressed interest in reintroductions of non-game species there are a number of actual formerly native vertebrate species that could benefit from a state sponsored reintroduction program. Of 32+ animals that historically occurred in Maryland 7 are now extinct, but another 20+ extirpated species still can be found in other places in North America (2 fishes, 2 amphibians, 1 reptile, 11 birds, and 9 mammals). Interestingly, the one extirpated species that was successfully reintroduced into the state, the peregrine falcon, *Falco peregrinus*, was done without any real support from DNR. We encourage DNR to look into to the possibility of returning some of these creatures to appropriate regions and habitats, rather than concentrating on "reintroduction" of a species whose range likely never included the Delmarva.

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Antics in the Name of Science

Herbert S. Harris, Jr.

During the past year and a half I have seen some unbelievable programs carried out by Maryland's Department of Natural Resources. Maryland's DNR should know better and yet they continue to tread in the same footsteps that have been pointed out by Maryland's herpetology community to be in error.

The latest example involves the "planned" introduction of a non-native species, the Pine Snake (*Pituophis m. melanoleucus*), on Maryland's lower Eastern Shore. Thirteen members of Maryland's herpetological community pointed out in a 25-page position paper (Ashton et al., 2007) to the Director and Deputy Director of DNR that *Pituophis melanoleucus* does not and has not occurred on the Delmarva within the Historic Period. In fact, it probably never occurred on the Delmarva but at least has not since the Pleistocene. The planned "reintroduction" is not that, but rather an introduction of a non-native species. Although, we have not been contacted in regards to this, others have received informal comments that the "Reintroduction" is now on hold.

Then recently we received a draft, via others, on "Maryland's DNR Regulations: Reptiles and Amphibians" to be put out for comments in late summer or early fall 2007. In the "This chapter regulates the possession, breeding, sale, offer to sell, trade, barter of certain native reptiles or amphibians .....", we find the Pine Snake, *Pituophis m. melanoleucus,* listed as a native species. What in the name of science does this imply? DNR has a motto "Inspired by nature, guided by Science." They have no idea, what so ever, what science is! Is the intention after these regulations are published in the Code of Maryland Regulations to implement the proposed Pine Snake "reintroduction" again, on the grounds it is now a native species? This again is politics, not science, and they apparently have no clue.

After our initial contact presenting our position paper, DNR proposed a public meeting at Towson University. They pulled a real political shanagan here. They lined up speakers presenting their view, casually mentioning ours, but basically laughing it off. We were not allowed to present our side. They then broke the audience down into six groups (they had mostly Towson University students in the audience). We had just enough of our people familiar with the issue to make sure we had representation in each group. A hand-picked leader and data recorder from the DNR staff then set the stage at each group meeting pushing their view. We were very vocal at these meetings and were able to get our point across. Then the vote was taken.

The results were supposed to be posted on DNR's website, but as time when on they were not. We had to contact the Deputy Director and remind him of his agreement to post the results. Apparently we had enough impact on the students that the results were not favorable to DNR. Again, this is politics not science. As of September 1, 2007, we still have not been contacted regarding our concern.

The next interesting thing that I became aware of was "Planet Frog...Live Frog Habitat" being sold by Discovery Channel Store, located in Baltimore's Inner Harbor, supposedly introducing kids to science. A friend had just built a large pond in his back yard (Millersville, Anne Arundel Co., MD), and the neighbors were tossing in their Discovery Kids' tadpoles. When I ask where they got the tadpoles I was told that the kit contained the name of a place in California where they purchased the tadpoles. On their website www.unclemilton.com I learned the tadpoles come from Frog Farm and were captive bred and represent the Northern Leopard Frog, *Lithobates pipiens*. Here in this area of the Coastal Plain Providence we have the Southern Leopard Frog, *Lithobates sphenocephalus*

utricularus (Harris, 1975). The most current technical publication on this group of frogs has listed these two frogs as separate species, but not all herpetologists are in agreement (Conant and Collins, 1998). The Southern Leopard frog *(L. s. utricularus)* is the one native to this area. This is another case of the introduction of non-native species with the potential for genetic problems.

The manual available on line stresses if you get tired of the tadpoles or frogs give them to a friend.... that is exactly what they did, by tossing them into his pond! No mention is made of not releasing them into the wild, except to say that they are captive raised and they would do better in captivity. Unlike the pine snake issue, this is not a DNR program; but, this is something that the agency should be addressing.

This reminds me of one of our current problems with Red-Eared Sliders, *Trachemys scripta elegans*, a feral turtle in our State and many others. These pet store turtles have been released in our waters since the early 1940's, and this practice continues today. DNR still allows the sale of these turtles, in local pet shops, although there is evidence that some hybridization can take place with native *Pseudemys* and even *Graptemys*. (Photographs of specimens in the collection of the Tortoise Reserve, Lee, unpublished). State law no longer allows young turtles to be sold and has established a carapace length of 4 inches for legal sale. This decision was again a political one, not because the turtles were polluting waters out of their native range, but because of the *Salmonella* (bacteria) scare in small turtles. Now, the pet stores just sell larger ones!

What is DNR thinking? They have the time and effort to try and justify the occurrence of the pine snake, a snake which as best we can tell never occurred in Maryland, get grants to "reintroduce" it, do press releases, and then sit back and let pet shops sell non-native species including the tadpole kits with Northern Leopard Frogs, Red-eared Sliders, and Three-toed Box Turtles (*Terrapene carolina triunguis*), which incidentally will interbreed with our native race, *T. c. carolina*. The U.S. Fish and Wildlife Service and many conservation groups recognize that the introduction of non-native species is one of the major conservation threats in this country, yet Maryland does not take a stand on these local issues. Why can not DNR just do their job and protect our native species from commercial interests and themselves!

Just as there is supposed to be in this Country, the reason for which it was founded, a separation of Church and State, there also needs to be a separation of Science and Politics!

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The effects of calcium on the feeding preference of the tadpole of *Bufo americanus*

Optimal diets not only require animals to intake enough energy to survive but also to take in the proper levels of nutrients. Some animals vary their diet considerably presumably to increase the chances of taking in the necessary nutrients (Thacker 1998; Waldbauer and Friedman 1991). Other animals will forage for particular nutrients especially if those nutrients are not readily available (Waldbauer and Friedman 1991). Many animals have been shown to alter their foraging behavior in response to macromolecules such as lipids and proteins; however, few studies have examined the effects of micronutrients on the foraging behavior of animals. In the field, animals have been shown to alter their diets in response to micronutrients such as sodium (Belovsky 1992; Willig and Lacher 1991) as well as calcium and phosphates (Willig and Lacher 1991) when these nutrients are limited in the environment.

Calcium is an important mineral in animal diets. Cellular division, metabolic pathways, and hormonal activity depend heavily on calcium (Frausto da Silva and Williams 2001). In vertebrates, calcium is particularly important for bone growth (Hossain and Furuichi 2000; Hossain and Furuichi 2001; Poulin and Brigham 2001). Thus, growing vertebrates presumably need a rich calcium source. Calcium hunger has been documented in a variety of organisms. Many animals appear to have the behavioral ability to forage for foods high in calcium content to meet dietary needs (Leshem et al. 1999a). Red squirrels (Willson et al. 2003) and common terns, *Sterna hirundo*, (Nisbet 1997) have both been shown to alter their diet under calcium poor conditions. Leshem et al. (1999a) has shown that calcium deprived parathydoidectomized rats will choose calcium enriched diets over magnesium and sodium enriched diets. This suggests that calcium detection is possible in vertebrates.

Like most larval amphibians, tadpoles undergo a period of rapid growth, and therefore, should need a source of calcium in their diet. The ability to detect such resources would allow them to exploit the calcium sources in their environment. Tadpoles have been found to use chemical cues to detect a variety of things in the environment such as kin (Blaustein and Waldman 1992; Fishwild et al. 1990; Pfennig et al. 1999; Pfennig 1995; Waldman 1979), predators (Belden et al. 2000; Spieler 2003; Wilson and Lefcort 1993) and food (Veeranagoudar et al. 2004). Little has been done to explore exactly what the tadpoles were cuing in on in the food studies. Given that calcium is probably an important component to a tadpole's diet, we tested whether tadpoles show a preference for calcium enriched food.

Materials and Methods

One hundred *B. americanus* tadpoles were collected from a ditch in Cape Girardeau County. Tadpoles were housed in an aerated tank for two days until they were used in a trial.

An artificial food source was created by mixing 3g of agar with 250 ml of water, heating, and then adding 10 g of crumbled Sally's Seaweed Salad© (composed of 100% dried seaweed). The mixture was divided in half. One half was enriched with 0.1 g $CaCO3$ while the other half was not enriched.

An arena was created from a 1.2 L plastic tub measuring 12.5 cm 18.5 cm x 6.5 cm half filled with water. Two lines were drawn across the bottom of the tub at opposite ends, creating 4 cm wide margins for feeding zones and a 10.5 cm wide area in the middle.

For each trial, fresh samples of the control and calcium enriched food mixtures were placed in feeding dishes at opposite ends of the arena. Ten tadpoles were released in the center for each trial. We monitored the location of the tadpoles every five minutes for a period of one hour.

If a tadpole was in either feeding zone they were considered to be feeding on that food. If they were in the middle, they were considered undecided. Each tadpole was only used once. A total of ten trials were performed. Sides in which the food was placed was randomized between trials to prevent bias.

In each trial, the tadpoles initially swam around the tub but settled down after about 30 minutes and began to choose sides. After 45 minutes the numbers on each side leveled off. The last four measurements of the number of tadpoles in each zone were averaged for each trial to come up with a preference score for each food source. The preference scores for all ten trials were used in a single Friedman Test followed by a Multiple Comparison Procedure (Daniel 1990) to determine which area was preferred.

Results

The calcium enriched food had significantly higher preference scores than the control food ($N=10$, $W=0.61$, $p<0.001$, Figure 1) suggesting the tadpoles were attracted to calcium enriched food.

Discussion

In this study we found that *B. americanus* tadpoles selected foods higher in calcium. There is a growing body of evidence that micronutrients such as minerals can alter an animals foraging behavior (Belovsky 1992; Chafetz and Duhon 1987; Leshem et al. 1999a; Leshem et al. 1999b; Lyford 1943). Growing animals such larval amphibians need larger amounts of many of their nutrients during this life stage. This is especially true for those found in ephemeral places (Crump 1983). It

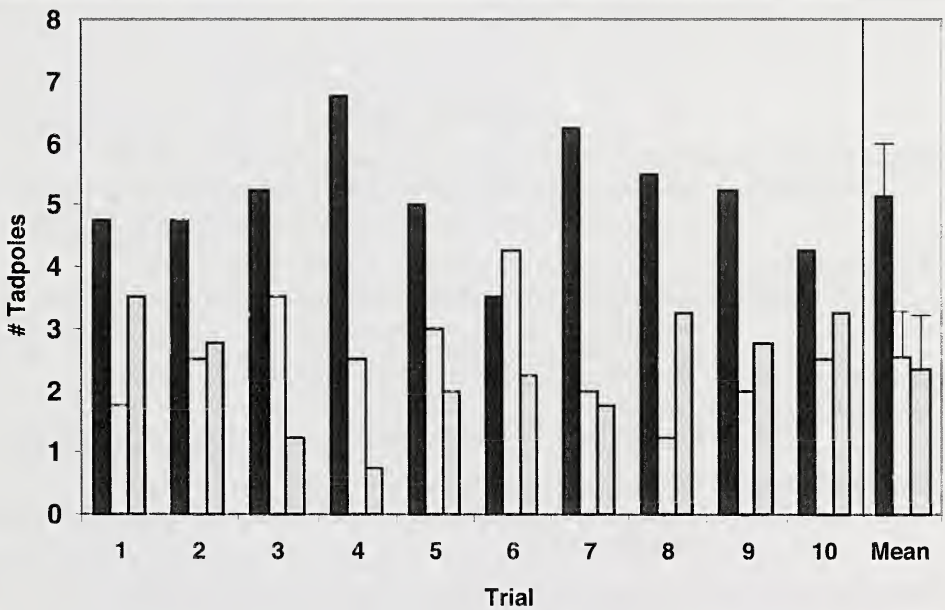

Fig.1. The preference scores (number of tadpoles) for the calcium enriched food (black) and control food (grey) for all ten trials and the mean (SE) of all ten trials (right). Overall the tadpoles preferred the calcium enriched food (Freedman Test, $N=10$, $W=0.61$, $p<0.001$, Followed by Multiple Comparison Procedure).

is possible that such animals are armed with a variety of senses to insure they obtain the most nutritious diets in a short period of time. Thus, larvae that live in a temporary water source not only have mechanisms to speed up metamorphosis to insure survival, but may also have mechanisms such as the detection of calcium that allow these individuals to maximize their nutritional intake.

Food availability has been shown to affect the behavior and development in amphibians. In many amphibians, environmental factors such as temperature, food availability, and crowding can alter larval developmental periods (Lane and Mahony 2002; Laurila et al. 2004; Laurila and Kujasalo 1999; Leips and Travis 1994; Nicieza et al. 2006) or even morphology (Crump 1983; Frankino and Pfennig 2001) of larvae. Amphibians will sometimes lay their eggs in temporary water sources (Laurila and Kujasalo 1999). In these situations, the larvae need to maximize their nutrient intake to grow and mature before the water disappears (Crump 1983). In addition, ditches such as the one our subjects were collected from, are potentially nutrient poor and could lead to larval malnutrition.

A few studies have documented cases in which animals will show preference for a particular nutrient when they are starved for that nutrient (Chafetz and Duhon 1987; Gross and Cohen 1953). Amphibians that live in temporal habitats that vary in nutritional quality seem to show phenotypic plasticity (Lane and Mahony 2002). It seems likely that these conditions would favor the evolution of nutrient hunger as well.

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The Wood Turtle, *Clemmys insculpta,* in Talbot/Queen Anne's County, Maryland?

The wood turtle, *Clemmys insculpta*, was first reported in Talbot Co., Maryland in 1939 by Norman (1939). William Norman collected this turtle crossing the road at night on 9 September 1939 near Easton, Talbot County Maryland. McCauley (1945) mentions this report and states that it may be a valid record, but due to the Coastal Plain locality he considered it an escaped pet. Reed (1956a, 1956b, and 1956c) reports the record as valid in his distribution studies. In Reed (1958) he again mentions the Talbot County report but goes a step farther in mentioning that in this coastal plain area there are a considerable number of Piedmont plants and animals.

Cooper (1960, 1965), Schwartz (1967), Harris (1969, 1975), Ernst (1972), and White and White (2002) all followed McCauley in assuming the Easton record was an escaped pet. Norden (1989), in a paper on the Wood Turtle on the Maryland Coastal Plain, mentions the Talbot County record and Reed's (1958) comments about Piedmont plants and animals that inhabit this area of the Delmarva.

On 22 July 2007, Kevin Crocetti and his friend, Kristen Kennedy, visited an area just outside Wye Mills (Wye Oak State Park) in Talbot County, Maryland to do some fishing. This area is in Talbot County along the Talbot County/Queen Anne's County line. There is a large body of water (in Queen Anne's County), a small spillway and a small stream that leads away (in both Queen Anne's and Talbot Counties, East Headwaters of Wye River). They encountered a young man and his dad who had just found a subadult wood turtle near the pond/lake. Kevin recognized the turtle immediately, but did not realize it's questionable status in Central Delmarva. He had his field Guides (White and White, 2002, Conant and Collins, 1998) and by the time he understood it's status, the young man had released the specimen. The carapace was estimated to be about 4 inches. Kevin and Kristin returned on 5 August 2007and searched the area, with out luck. Additional trips are planned. Other turtles seen here were Eastern Painted Turtles, *Chrysemys picta picta* and Northern Red-bellied Cooters, *Pseudemys rubriventris.*

This area, Wye Mills, is a very popular spot for both tourists and fisherman. If in 1939 the possibility existed for considering a wood turtle, in Talbot County, an escaped pet, in 2007, with the number of visitors to this area, and the number of turtles kept as pets, it is very possible unwanted pet turtles have been released here in this Talbot/Queen Anne's County locality.

Then again, with some Piedmont plants and animals known from this area, it is entirely possible a colony of wood turtles could very well exist here. In addition, as Norden (1989) has shown, there are in Maryland quite a number of Coastal Plain records for the wood turtle. We do know, there is at least one subadult wood turtle here. Whether it is an escaped or released pet or native still needs to be determined.

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News and Notes

In 2006 I learned of a plan proposed by Maryland DNR to "reintroduce" pine snakes to the lower Delmarva Peninsula. I was strongly opposed to this idea as sound documentation of its occurrence in Maryland as a native species was lacking. Furthermore, the natural hiatus in this snake's range that extended from southern New Jersey to extreme southeastern North Carolina was a zoogeographic pattern mirrored by a number of Atlantic coastal plain species. Late in 2007 I had a change of heart. I discovered that even though scientific evidence for the species' occurrence in Maryland was lacking the State itself now legally regarded pine snakes as natives. Thus, the species was to be documented as a resident through proposed DNR regulations. Somehow pine snakes got a green card and then full citizenship.

Proposed regulations state that pine snakes are native to Maryland after all, are protected by various legal codes, define their native status, can be grandfathered both as personal pets, and apparently as native species, and cannot be released into the wild. My guess is that these revised regulations, despite wording to the contrary, will now support our State to follow their primary goal of releasing pine snakes into the wild as originally proposed.

Title 08, Department of Natural Resources, Subtitle 03 Wildlife: 08.03.11 Reptile and Amphibian Possession and Permits (Maryland Register, Vol. 34, Issue 19 Friday, September 14, 2007 pages 1656-1661)

Under Reptile and Amphibian Possession and Permits. Statement of Purpose

(3) Add northern pinesnake to List B.

Under .02 B (5)

"Native reptiles and amphibians" means those species of reptiles and amphibians that naturally occur or historically occurred within Maryland not as a result of any action by humans.

Under .03 List of Native Species

B (d) Northern pinesnake (Pituophis melanoleucus melanoleucus)

We have all grown up under the foolish concept that there is to be a separation of science and politics just as there is a separation of church and state. Well both thoughts are clearly unrealistic and actually quite silly. We all need to work all together, and I want to be the first to step up and help. Because of this I felt it was important to justify the snakes' new legal status in biological terms. It's time to bury-the-hatchet and stop fighting our own government. This born again self-reflection resulted in what follows. I offer my sincere apologies to Maryland DNR for over reacting to their original proposal.

A previously unrecognized and possibly extinct subspecies of serpent from the lower Delmarva Peninsula.

Recently the Maryland Department of Natural Resources' staff dusted off a hand full of 30-60 year-old second-hand reports of pine snakes from the Delmarva Peninsula and concluded, despite the learned published opinions of numerous respected herpetologists that these reports were, after all, valid. The unverified reports were determined to be records, and by comparing published distribution maps of pine snakes generated in the early 1900's (Wright and Wright 1957, Stull 1940) with those

of more recent times (Conant 1957, 1975, Conant and Collins 1991, Mitchell 1994, Ernst and Ernst 2003, and others) they showed how the former range of this snake was contracting. Furthermore, the lack of new reports since 1972 and extensive field work during the last few years (Smith 2006) suggest that this snake, though never considered as being part of the state's indigenous fauna, has already been extirpated from the Maryland Delmarva. Furthermore, despite the lack of specimens, photographs, detailed or even adequate descriptions the Maryland populations of this snake had still been identified to the sub-specific level. To date all authors have referred to the elusive Delmarva pine snakes as *Pituophis melanoleucus melanoleucus*. None-the-less, after careful reading of the second-hand reports it is clear that the descriptions provided fail to match the published descriptions and known specimens of this snake in the documented portions of its range.

At a meeting in March 2007 at Towson University Maryland DNR staff and contracted speakers presented an overview of the undocumented historical information on pine snakes on the Delmarva. They also provided an in depth review of the potential habitat, soil types, plant associates, prey resources, and artificial den sites that suggested pine snakes could have, did, can, and should live on the Delmarva. In absence of information to the contrary it was concluded while no one can prove that pine snakes naturally occurred on the Delmarva, it was also true that there was clearly no evidence to indicate that they may not have ever lived here at all, like forever and ever.

The population is now shown to be absent from the region (Smith 2006) and it has become a priority to "reintroduce" them. Since there are no survivors to reintroduce, stock will be obtained in New Jersey and released on the Delmarva. Before this new introduced population becomes established I thought it is best to take the effort to document what we have learned about the original native population. Descriptive information shows the indigenous pine snakes to minimally represent a distinct, hither to unrecognized, sub-species. While taxonomic biologists will have trouble with the description and naming of a new taxon unseen, I should point out that this is not that different from redefining the distribution of a species based on no evidence, or assigning the nominate sub-species name to a population in the absence of any examined specimens. In all fairness, if indeed intelligent design is actually what dictates taxonomy, then this population is best considered a full species. For this contribution I will arbitrarily take a more conservative route and just consider this snake as a distinct sub- species.

***Pituophis melanoleucus delusionus* subsp. nov.**

Pituophis melanoleucus melanoleucus Kelly, Davis and Roberson, 1936.

Pituophis melanoleucus melanoleucus McCauley, 1945.

Pituophis melanoleucus melanoleucus Cooper, 1965.

Pituophis melanoleucus melanoleucus Harris, 1975.

Pituophis melanoleucus melanoleucus Grogan and Heckscher, 2001.

Pituophis melanolecuus melanoleucus Smith, 2006.

I name the new subspecies *Pituophis melanoleucus delusionus*, and propose the common name Elusive Delmarva Pine Snake. Based on extensive surveys over the last several years this previously unidentified race is believed to have become extinct in 1972 the date of its last reported occurrence (Smith 2006).

Type Locality: In absence of a verified locality record for this snake I hereby define the type locality as page 59 in Kelly, Davis and Roberson (1936) *Snakes of Maryland.* (The Natural History Society of Maryland, Baltimore). With a lack of material to designate anything as a type specimen I suggest that the description provided of the Worcester Co. sighting be considered as the type description. There appears to be no written description of the original, only, discredited (McCauley 1945), and subsequently lost specimen from the Maryland Delmarva. Despite it being referenced as housed in the collection of the Natural History Society of Maryland there is no record of its former or current existence in the archives of that institution, no accession number and no catalogue number have been found.

Holotype and other material examined: None, see above.

Description: Descriptions of taxon where specimens are lacking are always difficult. However, a number of the reports have descriptive information that serve to distinguish the Delmarva population from the nominate. Kelly et al. (1936) note that unlike the nominate that the type specimen had a head more turtle-like than snake-like, the sides were creamy white, darker on back, with more or less tan blotches on the dorsal region. Thereby the Delmarva population had different head shapes and different coloration patterns than the nominate. The Delmarva snakes had tan patches vs. black and their dorsal surface was creamy white and apparently lacked the lateral patches of typical *P. m. melanoleucus.* See Figure 1. Anyone of these features would in itself be of significance for distinction on a sub-specific level. In that the description is second hand the differences are likely to be even more striking than what the authors indicate. Unfortunately no information on variation in scale counts or DNA analysis of *delusionus* is available, and a DNA library for other known pine snake populations does not currently exist.

Size: These snakes would appear to be the same general size of typical Northern Pine Snakes. They range from four feet and four feet nine inches (Kelly et al. 1936) to "about six feet long" (McCauley 1945). Other reports state that these snakes are "large."

It is clear from these accounts that the published descriptions, though less than complete,

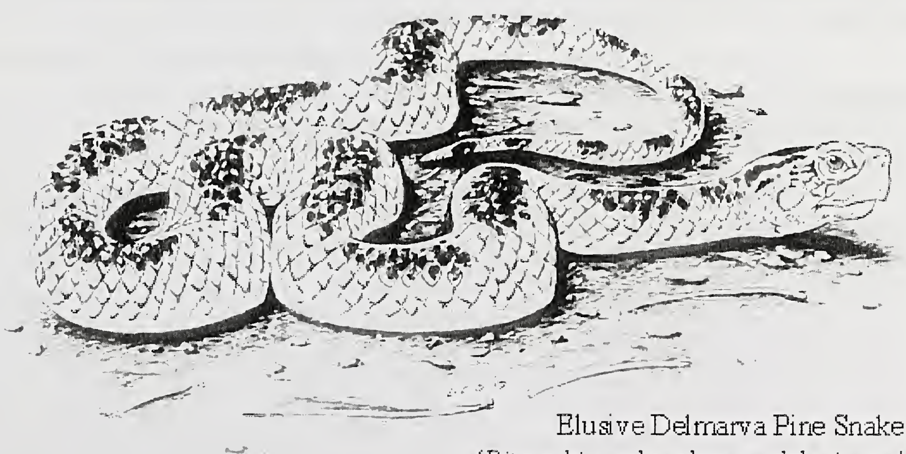

Figure 1. An artist redition of the Elusive Delmarva Pine Snake, *Pituophis melanoleucus delusionus.*

show as much differential in characteristics between Delmarva populations of *delusionus*, and known populations of *melanoleucus* as there is between the latter and other large native snakes. Other second and third hand published and unpublished reports that include descriptive information all match the original description (Kelly et al, 1936) of *delusionus* rather closely.

Distribution: Just like its presence, identification, and even existence, the distribution of this snake has always been problematic. The distributions of most organisms are defined by compiling accepted localities of occurrence. These distributions are further fine tuned by documenting additional areas or habitats where the species is known not to exist. This is not possible as there are no documented sites of occurrence for this race. But now that these out dated methods have been rejected by the staff of Maryland DNR it is no longer clear as to what criteria can actually be used to define distributional limits. A combination of unverified second-hand reports and currently available habitat suggest that these snakes did occur or should occur between Queen Anne's County and Worcester County, Maryland and in extreme western Sussex County, Delaware. Specimens of typical *P. m. melanoleucus* of questionable validity from Kent Co, Delaware and Anne Arundel Co. Maryland suggest that the Delmarva race does not occur on the Western side of the Chesapeake Bay nor in central and eastern Delaware. The Queen Anne's County specimen has been considered invalid (McCauley 1945) and all of the Worcester and Sussex County reports are in question. Thereby this sub-species is believed to have a very narrow geographic distribution. In fact the Delmarva Pine Snake may at the height of its maximum occurrence (between 1930 and1972) had the smallest documented distribution of any reptile known to science. It was clearly endemic to only the Delmarva where even there its presence was questionable. This sub-species has been documented from the following localities: Type locality (see above), sensitive data to be determined by, and available only from DNR heritage mapping program, Annapolis Maryland, and other unverified locality reports. A distribution map is provided by Smith (2006).

The Delmarva population is separated from all known populations by the Chesapeake and Delaware Bays, to the north and west by the Piedmont of the central Atlantic states, to the east by the Atlantic Ocean, and to the south by a vast hiatus on the outer coastal plain of Virginia and North Carolina. There are no reports from the Virginia portion of the Delmarva despite continuous open pine woods habitat extending southward into that state on the peninsula.

Behavior: While many of my academic collogues would consider it foolish to include behavior descriptions of a snake that has never been seen in the wild by any biologists it is actually possible to do so, The second hand reports, and what we are not finding, actually provide strong evidence as to the odd behavioral nature of this elusive serpent.

Activity: In that they are seldom seen and have not been reported as road kills, it is likely that the Delmarva population of pine snakes has different activity patterns than northern pine snakes or any of the bull snakes. They are clearly secretive and it is possible that they are nocturnal. Pine and bull snakes have distinctive heads and necks that serve as adaptations for burrowing but this is believed to be absent in the Delmarva population. Kelly et al. (1936) reports that the Delmarva pine snakes have heads that look like turtles and none of the 6 reports from Maryland mention the characteristic defensive hissing behavior of startled individuals. This latter information suggests that the neck anatomy is also different in the Delmarva population. The only behavior notes for Delmarva pine snakes is swimming (Lee 1972) so perhaps this is an aquatic species. More likely this snake is arboreal as already reported for pine snakes in the Blue Ridge of Virginia (Tobey 1985). Smith (2006) and Grogan and Heckscher (2001) both suggested that extensive timbering of the Delmarva in the late 1800's caused the decline and eventual extinction of this snake. In view of the fact that in other portions of its range (NC, for example) where extensive logging also occurred

this snake continues to be found and remains relatively abundant, logging alone should not explain its absence. The snakes still have stumps, stump holes, and slag piles for shelter, and the clearing of the forest increases the abundance of cotton rats, harvest mice, quail and other food items. In that this snake does not have burrowing adaptations and suffered from timber harvest, it would appear that the Delmarva subspecies is/or was arboreal in nature. This behavior would allow access to nesting birds, to night roosting crows and black birds, and tree roosting bats (5 species occur on the Delmarva, Paradiso, 1969); food sources untapped by most reptile predators. Successful predation on communal roosting birds would further confirm this population's nocturnal behavior, while the arboreal behavior would explain the complete absence of road killed specimen records.

Food: In that over half of the food items documented for the northern pine snake do not occur on the Delmarva (Ashton, et al. 2007) it is logical that alternate prey items be considered. Except for Delmarva fox squirrels no additional mammal species occur on the Delmarva that do not occur elsewhere in the northern pine snake's documented range. This would lead to the logical conclusion that the available prey base lives in greater densities on the Delmarva than they do elsewhere, or that individual snakes have larger foraging areas. There is no evidence of the former and the latter would suggest that this new sub-species would be encountered at greater frequencies due to extensive roaming than those snakes living outside the Delmarva area. However, an interesting secondary observation may shed some light on this issue. Not only have the snakes themselves never been documented from the Delmarva, but neither have their molted skins. In that one snake molts several times a season, and these shed skins would have no avoidance behavior, it is logical to assume that the molted skins would be encountered much more frequently than the snakes themselves. This is not the case. It is thereby assumed that the Delmarva pine snakes, as a result of a deficient prey base, have adapted the strategy of consuming their own shed skins at the time of molting. Less this sounds at first far fetched I should point out that several researchers documented survival in a captive sirens and amphiuma (*Siren lacertina* and *Amphiuma means*) that were retained for up to 5.2 years in a classroom aquarium. The authors concluded that they were living off of consuming their own shed skins and benefited from the bacteria and molds growing on the skin tissue. These observations were later reworded when it was learned that one of the University's cleaning ladies after seeing the sign saving "Do not feed, experiment in progress" felt sorry for the salamanders and often shared her baloney sandwiches with the creatures. Also see suspected avian and chiropteran feeding discussion above.

Reproduction: In New Jersey and North Carolina where pine snakes occur the nesting chambers and eggs of pine snakes are relatively easy for experienced herpetologists to locate. In that no nests or eggs of pine snakes have been even reported from the Delmarva this leaves open the question as to if this sub-species even reproduces. The extraordinary distances in both time and locality between the five existing Maryland Delmarva pine snake reports suggest that mate location and selection would indeed be difficult. Perhaps the sub-species described here does not reproduce at all and this would account for its overall rarity, decline and extinction by 1972. On the other hand it is possible that this race is parthenogenic eliminating the need to locate mates over vast distances of time and geography. Parthenogenesis is known in snakes (*Rhamphotyphlops*) and on the Delmarva this form of reproduction is likely to have developed through hybridization between the terrestrial and ancestral arboreal clades. Shifts of populations to asexual reproduction can occur in one generation and brief time periods (perhaps just hundreds of years in *Aspidoscelis* and *Cnemidophorus*). Thus, the shift may have resulted due to the post European contact changes in the landscape as suggested by Smith (2006). This, however, would not explain the lack of observations of nest or eggs. It therefore seems logical that this sub-species also differs from the nominate, and

other species and sub-species of *Pituophis* in being viviparous. Litter size is unknown, but size descriptions of these snakes as being "large" suggest that reproductive output is probably similar to well-known populations of pine and bull snakes.

Proposed Zoogeographic History: It would appear that ancestral Delmarva pine snakes first evolved in the area that is now the Delmarva Peninsula. This would have been during a time prior to the development of the Chesapeake and Delaware Bays (ca > 15,000 ybp). They most likely were derived from western "bull snake" type stock that moved eastward with Pleistocene Prairies. Because of inadequate late Pleistocene prey resources the snakes, after eliminating the food resources in their core range, gradually migrated outward over many generations in various directions. This was just prior to the rise of sea level and the formation of the current estuarine systems of the region. Thus, the ancestral pine snakes established out lying colonies to the north (what is now southern New Jersey) the west (mountains of Virginia) and the south (North Carolina coastal plain and sandhills). As a result of changing climate and landscapes, and the rise of sea levels and the construction of the Chesapeake/Delaware canal, these populations became disjunct and distributed more or less as they are today. This outward movement of pioneering populations and the decline of core stocks is exhibited by many organisms, but is perhaps best known in the ferry ring distribution in colonies of fungi, and the long distance movements of starving lemmings. The pine snake ancestral stocks that remained in the Delmarva region also migrated, in this case up and became the arboreal endemic sub-species described here. During the latter part of this process the pine snakes that retained terrestrial tendencies found themselves commuting for considerable distances to locate dwindling ground dwelling prey resources. Many of the snakes were actually leaving the state on prolonged foraging bouts. The gradual formation of the large Bays made this more and more difficult as time passed. (Note swimming behavior associated with one of the reports.) However, by the mid 1900s bridges and tunnels reconnected the Delmarva with the continent and the terrestrial pine snakes again had access to other parts of the eastern seaboard. In the 60s the new interstate transportation system supported by the Eisenhower administration was developed and the remaining population made use of this for their travels. This single factor (the total lack of interstate corridors on the lower Delmarva) probably accounts for the final disappearance of pine snakes from the Delmarva by the early 1970s and for the endless number of additional specimen records of road-killed pine snake that occur in other states that adjoin the Delmarva.

While direct evidence for portions of this scenario are lacking this is not anymore speculative than those of the former occurrence of pine snakes on the Delmarva, so if the latter is ever proven to be true a reasonable explanation is now available and the snake's taxonomic status and evolutionary history is established. In the absence of hard evidence this should make it easier to demonstrate to skeptics that pine snakes could have actually occurred on the Delmarva in the past, as they soon will legally occur there at present.

Discussion: I understand that publication and peer review is no longer a requirement for acceptance of the scientific thought process in agency decision making, However, as we can reasonably expect the Maryland DNR will attempt to establish pine snakes on the lower Delmarva based on their best judgments, it may be useful for them to understand the significance of this action, the rarity of the snake, and the unique nature of the elusive Delmarva pine snake. The uniqueness of the former population will help justify the listing of the released snakes as endangered and as primal habitats return to the Delmarva as a result of forestry management practices we might expect the released population to eventually evolve back to ones of the original *delusionus* type in both appearance and behavior.

On a personal note, and all teasing aside, it at first disappointed me to see that a state agency could ignore major contributions of our friends and collogues, selectively cherry pick information from various historical accounts, take statements out of context, and rearrange facts to put new spins on what had become established and long accepted facts. But they are right, why should the stuffy opinions of the previous generation be roadblocks to new ideas. Why should interpretations of local natural history be stagnated by factual information that people spent their entire careers developing? Most of these herpetologists are now deceased anyway. Think what advances we can make in our understanding of natural events if we are no longer burdened by the need for evidence such as good descriptions, photographs, specimens, fossil records, and peer reviewed literature. I feel a little guilty saying this but think how much more effectively we can fast track our careers and the reputations of our institutions and agencies if we are not bogged down by archaic scientific methods, evidence, literature reviews, publication or concerns for the respect of our collogues. The zoogeography of the Atlantic slope can be so much cleaner knowing that everything occurred everywhere, all forms of rarity and distributional anomalies are the result of European man's influence, and evidence to the contrary is unimportant because we actually understand all this, and frankly since the Biblical times always have. Advanced degrees, grants, awards, and other levels of achievement are unnecessary and we can all now just get right down to business.

Furthermore it clearly is not fair for New Jersey and North Carolina to have pine snakes when Maryland does not. Its simple, we deserve them. A state that cares for its other native biota, and lists 400 native species as state endangered does deserve this snake. This number is far more than even large states, in fact its more than most countries. Adding an additional endangered species will make it more difficult for them to exceed Maryland's listed species total. With all of DNR's expertise in looking after stressed plants and animals they deserve to take on more. And enforcing the protection pine snakes should be relatively easy as none apparently occur in the state anyway. Maryland has the resources to construct its own pine barrens and numerous additional species that occur to the north and south can now also eventually be added to our list of native and protected biota through publication in the Maryland Register.

While the author recognizes that much of what is reported here is speculation it is not any more speculative than what has been suggested and presented to date in the State's grant proposals, public meetings and news releases regarding the occurrence, origins, ecology, extinction, and proposed zoogeographic history of pine snakes on the Delmarva. I provide the above only to complement DNR's noble effort (Cleese 1998).

Leo Schleicher of LeoStudios prepared the illustration of *P. m. delusionus*.

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(While most authors of contributions of this type write under an alias, or invent names that rhyme with the names of collogues that share the same fields of interest; what's the point? Everyone will guess who wrote this anyway.)

News and Notes: Book Review

TURTLES OF THE WORLD, by Franck Bonin, Bernard Devaus, and Alain Dupré, translated by Peter C.H. Prichard. 2006. 416 pp. John Hopkins University Press, Baltimore, Maryland. ISBN 0-8018-8496-9. Hardcover $50.00.

The *Turtles of the World* was first published in French in 1996 and reprinted in 1998, with the present revision and translation provided for the 2006 edition by the eminent authority on chelonian systematics and ecology of these ancient creatures. In the translator's notes, Peter Pritchard provides a brief review of the major monographs that have been published on the chelonians of the world, beginning with Walbaumid's (1782) *Chelonographia*, to Vetter's most recent *Turtles of the World* published in English and German by Chimaria (2002-2004). The translator's excellent monographs, *Living Turtles of the World* (1967) and *Encyclopedia of Turtles* (1979) have become collectors items, and are highly sought after on the out-of-print market. Pritchard's monograph, *The Alligator Snapping Turtle*, published in 1989, also is a collector item, but recently has been reprinted in a revised edition by Krieger Publishing Company.

Following the translator's notes is a chapter on the general biology of the chelonians, covering such topics as the origin of the sauropsidans, with a description and figures of *Proganochelys* which Cope considered the ancestor of all turtles. This is followed by discussions on the skeleton, internal organs, sensory organs, sexual dimorphism, metabolism, ethology and last but most important, aspect of threats and protection for chelonian species.

The above is immediately followed by family and species accounts, beginning with the interorder Pleurodira. The Cryptodira represents the most ancient turtles, followed by an excellent color figure, along with a small color map showing the continent from which the species is found, along with a more detailed map showing the approximate distributional range within the respectful countries.

The species accounts comprise the major portion of the book, with no less than 384 pages devoted to same, with some 310 distinct species having been recognized by the authors from throughout the world. The majority of the species accounts are several pages in length, although others are relatively short, only because little is known regarding their natural history and distribution.

Each species account provides information on the systematics whenever necessary, but otherwise they provide a detailed description, followed by natural history notes, with information on reproduction and diet. A paragraph on the husbandry and protective status closes out each species account, except for the excellent color photographs for each of the 300 described species along with two color distributional maps.

The monograph closes with a short section on the sixty-six references cited, along with a scientific name index.

The cover design will certainly catch your immediate attention, and the publishers should be complimented on producing another attractive book for both the novice and professional herpetologist alike.

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News and Notes: Book Review

ANANJEVA, Natalia B., N.L. ORLOV, R.G. KHALIKOV, I.S. DAREVSKY, S.A. RYABOV and A.V. BARABANOV, Pensoft Publishers, Geo Milev Str. 13, 1111 Sofia, Bulgaria, 245 pp. 2006. **THE REPTILES OF NORTHERN EURASIA: TAXONOMIC DIVERSITY, DISTRIBUTION, CONSERVATION STATUS.** Available on line from Pensoft Publishers. 75.00 Euro, or $95.00 US. Cloth bound, ISBN 954-642-269-X

The cover photograph of *Vipera (Pelias) orlovi* will immediately catch your attention, and you will certainly want to see what lurks inside the cover. The opening figure following the table of contents will certainly captivate the reader with its panoramic view of Lake Markokol in eastern Kazakhstan.

The *Reptiles of Northern Eurasia* is illustriously illustrated with no less than 400 color photographs of reptiles, habitats and a generalized distributional map for each species. The book provides up-to-date information on all the species and subspecies of turtles (7 species), lizards (112 species), and 74 species of snakes inhabiting the northern Euracia territory. The North Eurasia region consists of what is know as the former Soviet Union and Mongolia.

The authors provide updates for two taxonomic and phylogenetic revisions that have not previously been cited in former references, but have been used in this superb monograph.

With the worldwide decline of amphibians and reptiles, Russia has also noticed a drastic decline in certain species, and has formed a North Eurasia Reptile Specialist Group, with the senior author presiding as chair of this conservation organization.

The present book provides up-to-date information on taxonomic diversity, geographical distribution and conservation status for all species inhabiting the territories of the former Soviet Union and Mongolia. The authors provide excellent descriptions for each of the genera found within the limits of the above noted territories.

The individual species accounts are rather short and concise, providing common and scientific names, type locality, distribution and conservation status. The reader must rely on the superb color photographs provided mainly by one of the junior authors, Nikolai L. Orlov, along with several other individuals, such as Konstaintin Milto, and Robert Macey having provided a single photograph.

The majority of the photographs are of superb quality, although a number of the species of *Eremias* and Elapidae have not been illustrated in the text. This may have been because they have been illustrated in numerous other publications, or the authors failed to have high quality prints for use. Overall, nearly all the species are illustrated with close-up color photographs of the highest quality. The Viperid photographs will leave you awe struck!

Following the species accounts the authors provide a short bibliography of publications recommended for reading on the herpetofauna of Russia and Mongolia, although the majority are in Russian.

The present monograph can be used as an illustrated reference manual for the reptiles of North Eurasia.

This book will certainly be a welcome addition for any professional herpetologist library, and any layperson interested in high quality photographs.

News and Notes: Book Review

The authors and Pensoft Publication Company have done a splendid job in organizing, and making this monograph available on such a little known area, at a time when conservation cannot be expressed enough, although the price seems rather exorbitant, it truly is worth its weight in gold when in need.

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News and Notes: Book Review

FOSSIL SALAMANDERS OF NORTH AMERICA, by J. Alan Holman. 2007. University of Indiana Press, Bloomington, Indiana. 232 pp. Cloth $55.95. ISBN 13-978-0-253-34732-9.

The recently deceased author was probably the most noted and recognized vertebrate paleontologist on amphibians and reptiles of North America, having published no less than seven excellent books relating to Pleistocene herpetology or other archeological endeavor, along with numerous scientific articles in major journals since 1955. The below listed works should be of interest to anyone keeping abreast on the herpetology of North America or Europe, and collector's will certainly want these titles on their book shelves. Many of these are still available through the respective university presses. Holman is the first to compile complete Herpetological monographs covering the Pleistocene fauna of the United States since Gilmore (1928, 1938), which have long been out-of-print, except the former that was recently reprinted by Riverside Museum Press in 1978.

The opening chapter, or Introduction, provides an excellent overview of the evolutionary relationships of what is known on salamander classification, which is primarily taken from the recent book, *Amphibian Biology, Vol. 4*, by Heatwole and Carroll (2000), and Duellman and Treub (1986). Nomenclature follows Crother et al. (2000, 2003), without mention of Collins and Taggart (2002).

The systematic species accounts are the bulk of the contents of this volume with 140 pages of descriptive information on each family, genera and species along with the author's feelings regarding origins of each when necessary. Each species account is provided with detailed information on the type specimen, along with comments on all other available material presently known, and black and white illustrations of the vertebrae for each species covered within the text. The author provides information of current scientific name, holotype, type locality, horizon, diagnosis, description of holotype, and comments on other material and current taxonomy.

The author's humor is brought forth in his comment on capturing *Sirens*. He states "do not think about frying removed muscles after preparing specimens for maceration as they look like eels and taste like mud."

The species *Paleoamphiuma tetradactylum* Rieppel and Grande, 1988 was assigned to the Amphiumidae, although the author has assigned this species to the family Sirenidae. Another species *Necturus krausei* was described by Naylor in 1978 from a single incomplete trunk vertebra from the Ravenscrag formation, southern Saskatchewan, and the author was unable to find any distinctive characteristics seperating this species from *N. maculosus*. The *Plethodon glutinosus* group has been divided into over 13 distinct species with no subspecies being recognized. This makes fossil material impossible to distinguish from one another. The genus *Amphitriton* Rogers (1976) is considered a synonym of *Ambystoma*.

The author provides detailed systematic descriptions for no less than 87 species of fossil amphibians found in North America, re-diagnosing or redescribing species on the basis of additional comparative recent and fossil material. This is followed by a chapter on the chronological accounts from the Jurassic through the Pleistocene era, with an overview of the salamanders in the Pleistocene. This includes an excellent review of the extent of the glacial ice sheets, and their effects on the distribution and extinction of fauna.

Two families of salamander-like amphibians (Batrachosauroididae and Scapherpetonidae) are assigned with the salamanders, but it is uncertain if they were actually related to living salamanders. Many species of salamanders are indistinguishable from one another (*Desmognathus*) on the basis of recent and fossil remains, and probably will never be resolved until a technique for

extracting DNA from fossil forms is devised.

The book ends with an extensive reference section relating to fossil salamanders.

We would highly recommend this important monograph for anyone interested in recent and fossil salamanders in general.

The thorough descriptions of families and species give a good indication of the author's life-long love for details, and devoted love for vertebrate paleontology. Everyone having known Dr. Holman, or having an interest in vertebrate fossils will certainly want a copy for remembrance or need a copy as a tool for future research in the field of amphibian fossil history, or amphibians in general.

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News and Notes

Society Publication

Back issues of the Bulletin of the Maryland Herpetological Society, where available, may be obtained by writing the Executive Editor. A list of available issues will be sent upon request. Individual numbers in stock are $5.00 each, unless otherwise noted.

The Society also publishes a Newsletter on a somewhat irregular basis. These are distributed to the membership free of charge. Also published are Maryland Herpetofauna Leaflets and these are available at $.25/page.

Information for Authors

All correspondence should be addressed to the Executive Editor. Manuscripts being submitted for publication should be typewritten (double spaced) on good quality 8 1/2 by 11 inch paper with adequate margins. Submit original and first carbon, retaining the second carbon. If entered on a word processor, also submit diskette and note word processor and operating system used. Indicate where illustrations or photographs are to appear in text. Cite all literature used at end in alphabetical order by author.

Major papers are those over five pages (double spaced, elite type) and must include an abstract. The authors name should be centered under the title, and the address is to follow the Literature Cited. Minor papers are those papers with fewer than five pages. Author's name is to be placed at end of paper (see recent issue). For additional information see *Style Manual for Biological Journals* (1964), American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

Reprints are available at $.07 a page and should be ordered when manuscripts are submitted or when proofs are returned. Minimum order is 100 reprints. Either edited manuscript or proof will be returned to author for approval or correction. The author will be responsible for all corrections to proof, and must return proof preferably within seven days.

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THE NATURAL HISTORY SOCIETY OF MARYLAND, INC.

MDHS .... A FOUNDER MEMBER OF THE EASTERN SEABOARD HERPETOLOGICAL LEAGUE

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Membership Rates

Membership in the Maryland Herpetological Society is $25.00 per year and includes the Bulletin of the Maryland Herpetological Society. Foreign is $35.00 per year. Make all checks payable to the Natural History Society of Maryland, Inc.

Meetings

Meetings are held monthly and will be announced in the "Maryland Herpetological Society" newsletter and on the website, www.marylandnature.org.

Testicular Cycle of the Western Diamondback Rattlesnake, *Crotalus atrox* (Serpentes: Viperidae), from Arizona

Abstract

Reproductive tissue was examined from 67 adult male *Crotalus atrox* museum specimens from Arizona. *Crotalus atrox* follows a seasonal testicular cycle in which spermiogenesis occurs from June to October. Regressed testes were found primarily in winter-spring. This cycle is consistent with the aestival type of spermatogenesis (*sensu* Saint Girons, 1982) which has been found to occur in other North American rattlesnakes. Vasa deferentia contained sperm from February to October. As has been found in other North American rattlesnakes, sperm produced the previous autumn are stored over winter in the vasa deferentia.

The western diamondback rattlesnake, *Crotalus atrox* frequents arid and semi-arid habitats from Arkansas and eastern Texas, through Oklahoma, New Mexico to southeastern California and south into northern Sinaloa and San Luis Potosí, México (Stebbins, 2003). The only histological information on the testicular cycle of *C. atrox* is from Jacob et al. (1987) who reported on July-September samples from Chihuahua, Mexico. The purpose of this paper is to present histological data on the complete testicular cycle of *C. atrox* from an examination of museum specimens collected in Arizona to faciltate comparisons with the timing of testicular cycles of other rattlesnakes.

Methods

A sample of 67 adult male *Crotalus atrox* (Mean snout-vent length, SVL = 830 mm ± 162 SD, range = 541-1300 mm) from Arizona was examined from the herpetology collection of the University of Arizona, Tucson (UAZ). Specimens examined by county are in the Appendix. The snakes were collected 1951 to 1998.

The left testis and vas deferens were removed for histological examination. Tissues were embedded in paraffin and cut into 5 μm sections. Slides were stained with Harris' hematoxylin followed by eosin counterstain. Testis slides were examined to determine the stage of the testicular cycle as presented in Goldberg and Parker (1975). Not all vasa deferentia were available for examination as some snakes were road-kills with damaged or missing organs.

Results

Testicular histology was similar to that reported by Goldberg and Parker (1975) for two colubrid snakes, *Masticophis taeniatus* and *Pituophis catenifer* (= *P. melanoleucus)* and the viperid snake, *Agkistrodon piscivorus* by Johnson et al. (1982). The testicular cycle of *C. atrox* from Arizona is broken into the six stages of Goldberg and Parker (1975) and presented in Table 1. These stages are: (1) Complete regression (= resting); spermatogonia and Sertoli cells predominate. (2) Early recrudescence (= recovery for next period of spermiogenesis); spermatogonial divisions and primary spermatocytes predominate (3) Late recrudescence; secondary spermatocytes and undifferentiated

Table 1. Monthly distribution of six conditions (see Goldberg and Parker, 1975) in seasonal testicular cycle of Arizona *Crotalus atrox* from UAZ museum specimens.

Month	N	1	2	3	4	5	6
February	3	1	2	0	0	0	0
March	3	3	0	0	0	0	0
April	8	4	1	3	0	0	0
May	5	0	2	3	0	0	0
June	8	2	0	3	0	3	0
July	9	1	2	0	0	6	0
August	13	0	0	0	1	12	0
September	11	0	0	0	0	10	1
October	7	1	0	0	0	5	1

spermatids predominate. (4) Early spermiogenesis (= sperm formation); metamorphosing spermatids are present. (5) Spermiogenesis; abundant sperm are present in lumina. (6) Early regression; germinal epithelium is one to three cells thick.

The period of spermiogeneis encompased June to October (Table 1). The majority of snakes with testes in complete regression (10/12 83%) (stage 1) were from the spring. The one October male (Table 1) with a regressed testis may have finished spermiogenesis. The period of testicular recrudescence occurred in spring (Table 1).

The smallest reproductively active male (stage 5 spermiogenesis) measured 541 mm SVL (UAZ 27303). Males smaller than this size were not included in the cycle to avoid including immature *C. atrox* in analyses of the testicular cycle. Histological examination was done on males smaller than 541 mm SVL but none were found to be undergoing spermiogenesis or have sperm in the vasa deferentia.

Sperm were present in 35/40 (88%) in vasa deferentia examined. These were: February 2/2; March 1/1; April 4/4; May 3/3; June 3/5; July 3/5; August 7/8; September 7/7; October 5/5.

Discussion

Data on the testicular cycle of *C. atrox* in Arizona as described herein along with the findings of Jacob et al. (1987) on *C. atrox* from Chihuahua, Mexico, in which early spermiogenesis occurs during July and spermiogenesis takes place during August and September, indicating a testicular cycle similar to that of other North American rattlesnakes (Aldridge, 1979; Aldridge and Brown, 1995; Goldberg, 1999a, b, c, 2000a, b, c, 2002, 2004; Goldberg and Holycross, 1999; Goldberg and Rosen, 2000; Holycross and Goldberg, 2001; Goldberg and Beaman, 2003a, b; Goldberg et

al., 2005). In these species of rattlesnakes, sperm is stored over winter in the vasa deferentia from spermiogenesis that occurred during the previous summer and fall. Mating occurs in the spring with some also occurring in autumn (Ernst and Ernst, 2003). Timing of events in this cycle is consistent with the aestival type of spermatogenesis (*sensu* Saint Girons, 1982) which has been found to occur in other North American rattlesnakes At this point, it appears that spermiogenesis is restricted to summer-autumn in North American rattlesnakes. Campbell and Lamar (2004) list 30 species of *Crotalus* and 2 species of *Sistrurus*. Histological examination of testes from at least 14 of these species will be required to further ascertain the seasonal timing of spermiogenesis in rattlesnakes.

Acknowledgement

I thank the late Charles H. Lowe (University of Arizona, Department of Ecology and Evolutionary Biology) for permission to examine *Crotalus atrox*.

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Appendix

The following specimens of *Crotalus atrox* from Arizona were examined from the herpetology collection of the University of Arizona, Tucson (UAZ).

COCHISE COUNTY, 27146, 31195, 32786, 41767, 42487, 50561, 50810; GILA COUNTY, 27304; GREENLEE COUNTY, 27101; MARICOPA COUNTY, 13561, 27223, 27224, 27237, 36197, 44077; MOHAVE COUNTY, 13552, 28281; PIMA COUNTY, 13554, 13557, 13560, 13562, 13563, 27100, 27106, 27114, 27122, 27145, 27169, 27173, 27174, 27176, 27177, 27207, 27208, 27210, 27211, 27225, 27235, 27236, 27292, 27295-27297, 27302, 27303, 27307, 27316, 27317, 27325, 27667, 27743, 42597, 42606, 42698, 44241, 44242, 50648, 51013, 51580 PINAL COUNTY, 27115, 27212, 27213, 27231, 27324, 42893, 42977; YAVAPAI COUNTY, 50808.

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Axial bifurcation and duplication in snakes. Part II. Report on a dicephalic *Zamenis longissimus* from Croatia

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Axial bifurcation and duplication are known to occur in no fewer than 169 species of snakes in 93 genera and eight familes (Wallach, 2007). *Zamenis longissimus* (Laurenti, 1768) is a nonvenomous colubrid snake that inhabits southern Europe (Arnold, 2002). Two cases of dicephalism in *Zamenis longissimus* have previously been recorded in the literature (Strohl, 1925; Radovanovic, 1957). In 1902 a 250 mm prodichotomous juvenile was found in the vicinity of Knin, Croatia (ca. 44°N, 15°E) (Strohl, 1925). It is now preserved in the Vienna Natural History Museum (NMW 19493) and was discussed and figured by Cunningham, 1937 (figs. 88-89), who showed it to have about 25 vertebrae in each neck. In November, 1949, a 280 mm prodichotomous specimen was collected by D. Stankovic at Banjska River about 10 km from Kursumlija, Bosnia-Hercegovina (ca. 43°50'N, 19°00'E) (Radovanovic, 1957). It is preserved in the Zoologischen Institut der Universität Belgrad (catalogue number unknown).

The third record of an *Zamenis longissimus* with two heads was collected by Sinisa Urbanovic, a forester in the Tikves Forest Department, near Zlatna Greda in the Kopaki rit Nature Park, Baranja, northeastern Croatia (ca. 45.5°N, 19.0°E) on 30 September 2002 (Stojcic, 2002; Soudil, 2003). The specimen is prodichotomous had two fully formed heads connected ventrally by a flap of skin and measured 288 mm in total length (Figs. 1-2).

The heads are symmetrical. Both heads fed and each head was dominant on one day or the other. Sometimes, when one head was feeding, it was attacked by the other head. It died in February 2003 after four months in captivity. It is preserved in the Muzej Slavonije Osijek (Pr-4316).

It is interesting to note that all three cases of dicephalism in *Zamenis longissimus* are prodichotomous and originate from the Balkan region.

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Nuptial Coloration In Female *Liolaemus Quilmes* (Iguania: Liolaemidae): Ambiguity And Keeping Males Interested?

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Abstract.

Nuptial coloration in female lizards has intrigued many researchers. Several hypotheses have been proposed. Although it is generally agreed that it signals the breeding status of the female, it is often not clear whether it signals a receptive or a non-receptive female. We studied nuptial coloration in natural conditions in female *Liolaemus quilmes* from northwestern Argentina. We captured, measured, and photographed 130 females during three periods of their active season, November, January and March. We classified their neck colorations into three categories: non-colored, medium and intensely colored. After processing, each female was released at the site of capture. Intensely colored females occurred only in November whereas the medium and non-colored females were present during the three months of the study. The medium and intense colors could not predict whether a female was gravid or not since their weights did not differ significantly. However these females were significantly heavier than non-colored females which may need another summer to become reproductively active. In November, there was no significant difference in frequency of color types. In January, there were significantly more medium colored females and in March significantly more non-colored females, showing a gradual fading of coloration. Males courted females of any color type throughout the active season but females accepted males only in November. We found no consistent pattern between female color type and their breeding status. Intense and medium colored females included receptive, gravid and post-oviposition females. It is suggested that the ambiguity in the color signal and its attractiveness to males may benefit females by keeping males interested, possibly protecting them and their progeny from harassing males.

There have been several attempts at understanding the function of nuptial coloration in female lizards (review in Cooper and Greenberg, 1992). Although the general consensus is that it signals female breeding status to males (Ferguson, 1976; Cooper and Crews, 1988), it is often not clear whether nuptial coloration indicates receptivity (stimulating male response and courtship) or gravid condition (inhibiting male response).

Female nuptial coloration responds to hormonal changes related to the ovarian cycle (Cooper and Crews, 1987; Medica et al., 1973). It generally appears just before ovulation peaks, becoming more intense when the female is gravid, after which the color gradually fades away (e.g., *Crotaphytus collaris*, Ferguson, 1976, Fitch, 1956; *Gambelia wislizeni*, Medica et al., 1973 - Crotaphytidae; *Holbrookia propinqua*, Clarke, 1965, Cooper et al., 1983; *Sceloporus virgatus*, Vinegar, 1972; Weiss, 2002 - Phrynosomatidae). Changes in female coloration during the breeding season have also been reported in the phrynosomatid lizards *Cophosaurus texanus* and *Callisaurus draconoides* (Clarke, 1965).

Some studies report females with breeding colors to be receptive (e.g., *Crotaphytus wislizenii*, Montanucci, 1965; *C. collaris*, Baird, 2004 - Crotaphytidae; *Chamaeleo chamaeleon*, Cuadrado, 1998*a*, 1998*b*, 2000 - Chamaeleonidae; *Ctenophorus ornatus*, LeBas and Marshall, 2000 - Agamidae), and others to be non-receptive (e.g., *Sceloporus virgatus*, Vinegar, 1972 - Phrynosomatidae; *Ctenophorus maculosus*, Olsson, 1995, Olsson and Madsen, 1998 - Agamidae). Colored non-receptive females are believed to be gravid, becoming aggressive at approaching males, often displaying the typical iguanian sidlehoping rejection posture (Carpenter and Ferguson, 1977). Nevertheless, colored receptive females have also been observed to reject males, probably an indication

that they are choosing their mates (Cuadrado, 1998*a*). On the other hand, colored non-receptive females, presumably gravid, have been observed to copulate (Werner, 1978). Still other reports mention that occasionally females with no colors were found copulating (e.g., *Crotaphytus wislizenii*, Medica et al., 1973). As LeBas and Marshall (2000) observed, the matter is far from clear except for the fact that female coloration seems to be related to female reproduction.

An alternative hypothesis to the receptive and non-receptive propositions is the conditional signal (Cooper and Greenberg, 1992). In this case, appearance of coloration indicates female receptivity whereas full color brightening indicates that the female is gravid and she will no longer accept a male. An example is the prhynosomatid *Holbrookia maculata*, in which females show low-intensity coloration when receptive but become intensely colored when gravid, rejecting male courtship (Hager, 2001). Although this hypothesis better explains the observed changes in coloration, it does not explain why many post-ovipositional females still retain color, or how a male distinguishes a receptive from a non-receptive female based on color variation when it is gradual and when it may vary among individuals, the latter possibly related to health condition and quality of female (Weiss, 2006).

Although odors may play a role in helping a male determine a female´s reproductive status, particularly at close range (Lopez and Martin, 2001), here we consider the visual signal and its possible functions. Our working hypothesis is that by developing gradual coloration during the breeding season, ranging from the receptive to gravid to post-oviposition periods, females are in essence being ambiguous relative to their breeding status. Males, on the other hand, are attracted to female nuptial coloration (e.g., Baird, 2004), apparently whether light or intense, courting any colored female. In such a scenario, a male might maintain interest in females residing within his home range, not knowing when they are actually fertile, thus keeping other males away. This may be especially true for territorial species although it may also occur in species that are not territorial but have been found in pairs during the reproductive season (e.g., *Gambelia wislizenii*, Montanucci, 1965). Foreign males may harass females and they have been known to predate on juveniles (e.g., Jenssen et al., 1989; Halloy and Halloy 1997).

We studied female breeding coloration in the neotropical iguanian lizard, *Liolaemus quilmes* (Liolaemidae), in order to determine whether it was associated to female receptivity, pregnancy or post-oviposition, fitting into one of the above propositions. During the austral spring and summer, when this species is active, some adult females show a patch of color on each side of the neck that ranges from light yellow to an intense orange or reddish-brick coloration. Etheridge (1993) observed female coloration in this species, as well as in the related species *L. koslowskyi* and *L. abaucan*. He suggested that the coloration might indicate gravid females.

Natural History. *Liolaemus quilmes* belongs to the *darwinii* complex (Etheridge, 1993), within the *boulengeri* group (Etheridge, 1995), in a genus of more than 160 species (Schulte et al., 2000). This species occurs in northwestern Argentina, occupying arid to semi arid habitats of the Monte (Cei, 1993; Etheridge, 1993) and Prepuna phytogeographic provinces (Halloy et al., 1998; Cabrera and Willink, 1980, for phytogeographic provinces). It is found at elevations between 1600 m to just below 3000 m (Etheridge, 1993). This liolaemid lizard is a diurnal, insectivorous, and oviparous species (Ramirez Pinilla, 1992). Males of *L. quilmes* are larger than females (average snout-vent-lengths of 66 and 61mm, respectively, Etheridge, 1993; Halloy, 1996) and more colorful. *Liolaemus quilmes* is a territorial species, males defending territories against other males, and overlapping with two or three females. Although females have smaller territories than males, they may overlap with more than one male (Halloy and Robles, 2002). Both males and females use visual displays, such as headbobs, forelimb waves, and tail movements, during encounters as well as during courtship (Halloy, 1996; Martins et al., 2004; Halloy and Castillo, 2006). Males emerge

from hibernation in September whereas females appear about a month or two later (Halloy and Robles, 2003). Mating occurs at the end of October and in November, neonates appearing at the end of December and in January (Ramirez Pinilla, 1992). Both males and females remain active until March or April when they return to hibernation.

Materials and Methods.

We studied a population of *Liolaemus quilmes* in natural conditions, at Los Cardones, Tucumán province, Argentina (26°40'1.5"S, 65°49'5.1"W, datum: WGS84; elev. 2725 m) where it occurs syntopically with *L. ramirezae*. The area is characterized by firm substrate, scattered with large rocks, shrubs and cacti (Halloy et al., 1998). We studied females during six different periods, in March and November 2003, in March and November 2004, and in January and March 2005. November includes the receptive to gravid period, January, the gravid to post-oviposition period, and March, the post-oviposition period.

Female *L. quilmes* were captured by noosing, measured (snout-vent length and total length) and weighed. They were then marked with a unique combination of two colored beads attached to the base of the tail with a surgical steel monofilament strand (Fischer and Muth, 1989; Halloy and Robles, 2002). A photograph was taken of the lateral area of the neck and head of each female. Females were then released at the site of capture. Photographs were taken using a Canon Rebel G camera, with a Sigma 28-80 mm Macro Zoom lens. All photographs were taken using Kodak film, against a standardized background at the study site, with the sun lighting the subject.

To define colors, instead of using color charts, each female was compared to the other females and placed in a class of more or less colored. Since change in coloration was gradual, it was difficult to establish categories. We attempted several classifications, shuffling photographs several times and assigning them to potential categories. We were able to be consistent in reassigning the photographs correctly when considering the following three categories: 1) not colored; 2) slightly to medium colored; 3) intensely colored.

We pooled results for the two November periods and the three March periods, since there were no significant differences in the number of color types and corresponding measurements. Intense colored females were found only in November. The Mann-Whitney test for large samples (z) was used to determine differences between the weights of different color types for the different months (Siegel and Castellan, 1988). Chi-square goodness-of-fit tests were used to compare the frequency of the three color types for November, and the frequency of medium and non-colored females for January and March.

Results.

A total of 130 adult female *Liolaemus quilmes* were captured. Their average snout-vent lengths and weights by month and color type are shown in Table 1. Snout-vent lengths remained similar throughout the three study periods. Average weights decreased in January in non-colored as well as medium colored females coincident with oviposition time, increasing again by March, right before cold weather and hibernation started.

The weights of different female color types were compared within each month-category (Table 1). In November, because medium and intense-colored females were not significantly different with respect to their weights ($z = 0.72$, $p > 0.05$), these were pooled to compare to non-colored females. The results were significant ($z = 2.44$, $p = 0.01$). Medium and intensely colored females were significantly heavier than non-colored females. In January and in March, we found no significant differences between the weights of medium and non-colored females ($z = 0.99$, $p >$

Table 1.

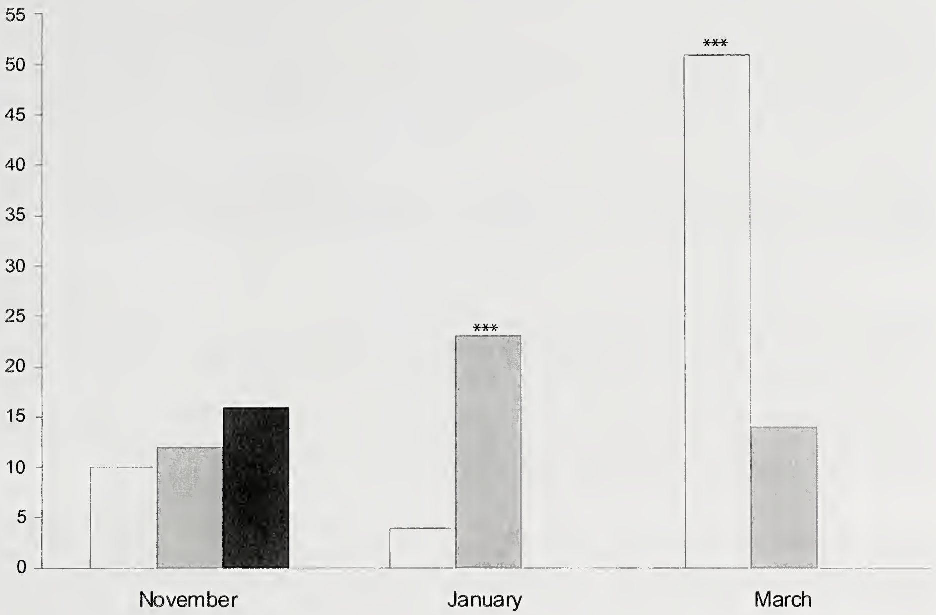

TABLE 1.- Averages ± 1 standard deviation of snout-vent length, SVL, in cm, and weight, in grams, of three types of female *Liolaemus quilmes* neck colorations during three months of their active seasons.

FIGURE 1.- Number of female *Liolaemusquilmes* (y-axis) with intense nuptial neck coloration (black), medium neck coloration (grey), and without neck coloration (white) during three months of their active seasons (x-axis). Chi-square goodness-of-fit test, *** p < 0.001.

	No color			Medium			Intense		
	N	SVL	Weight	N	SVL	Weight	N	SVL	Weight
November	10	5.8±0.2	5.8±1.1	12	5.9±0.1	7.1±0.6	16	5.9±0.2	6.9±1.3
Janury	4	5.9±0/1	5.6±0.8	23	5.9±0.3	5.2±1.0	0	_	_
March	41	5.8±0/3	6.1±1.1	14	6.0±0.3	6.4±1.1	0	_	_

0.05; z = 1.01, p > 0.05, respectively).

The number of females with different neck color types were compared for November, January, and March (Fig. 1). In November, no significant differences were found among the three color types ($X^2 = 1.48$, df = 2, $p > 0.05$). However, in January, there were significantly more medium-colored than non-colored females ($X^2 = 13.37$, df = 1, $p < 0.001$). In March, the reverse was true. There were significantly more non-colored than medium-colored females ($X^2 = 21.06$, df = 1, $p < 0.001$).

Discussion.

Medium and intensely colored female *Liolaemus quilmes* seem to indicate actively breeding females although a clear correlation between breeding status and color type could not be established. Medium and intensely colored females did not differ in their weights as could have been expected if there were a conditional signal as Hager (2000) proposed for *Holbrookia maculata*, i.e., females showing low intensity coloration when receptive becoming more intensely colored when gravid. Although the weight of an individual female *L. quilmes* may indicate its gravid condition, considering the color category could not predict whether a female was receptive or gravid. On the other hand, medium and intensely colored females were significantly heavier than non-colored females. These females may need another summer to grow and become reproductive (Halloy, 2006) although males already responded to them.

Most females were colored in November (medium and intense, 73.7 %) and in January (medium, 85.2 %, Table 1). Thus, overall, more than three-fourths of the adult female population presented nuptial neck coloration during months that corresponded to receptivity, gravid condition, as well as post-oviposition. By March, once the reproductive season was over and about a month prior to entering hibernation, only 21.5 % of females still had some neck coloration. Gradual fading of coloration during the lizards'active season followed a similar pattern observed in other iguanian species (e.g., Ferguson, 1976; Cooper et al., 1983).

Although *L. quilmes* males were observed courting females throughout spring and summer, females accepted males only in November when copulations ocurred (pers.obs.). At other times, females signaled rejection to males by displaying the typical sidlehoping posture (Carpenter and Ferguson, 1977; Halloy, 1996). Male *L. quilmes* seemed to be attracted to female nuptial coloration as reported for other species (e.g., Cuadrado, 1998*a*; Amundsen, 2000; Baird, 2004). However, they appeared to not clearly distinguish when a female was receptive or gravid, based on her neck coloration, since they courted females of the three color types. In another species, male *Sceloporus virgatus* associated more with more colored females than not (Weiss, 2002).

The ambiguity of the color signal, not clearly indicating receptivity or gravid condition, may benefit females by keeping particular males interested, possibly guarding them from other males (e.g., *Chamaeleo chamaeleon*, Cuadrado, 1998*c*; *Psammodromus algirus*, Martin and Lopez, 1999). It has been suggested that females may deceive males about their reproductive state when they gain direct benefits from doing this (LeBas et al., 2003). Here, an ambiguous color signal in breeding females could benefit them by keeping males interested and in the process, protect them and possibly their progeny from other males. This is something that needs to be explored further.

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Observations on the Diets of an Anuran and Eight Lizard Taxa from Sonora, Chihuahua,and Coahuila, Mexico, with Some Notes on Clutch Sizes

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Abstract.

We examined the diets of one species of anuran (*Gastrophryne olivacea*) and eight taxa of lizards (*Phrynosoma cornutum, P. orbiculare, Sceloporus albiventris, S. cyanostictus, S. jarrovii, Uma paraphygas, Uta stansburiana elegans, U. s. stejnegeri*) from the Chihuahuan Desert and surrounding regions. Insects dominated the diets of all of the species examined. We also provide observations on clutch size for *P. cornutum, S. albiventris, S. jarrovii*, and *U. s. stejnegeri.*

Resumen

Examinamos la dieta de una especie de anuro (*Gastrophryne olivacea*) y ocho taxa de lagartijas (*Phrynosoma cornutum, P. orbiculare, Sceloporus albiventris, S. cyanostictus, S. jarrovii, Uma paraphygas, Uta stansburiana elegans, U. s. stejnegeri*) del Desierto de Chihuahua y áreas cercanas a éste. Los insectos dominaron las dietas de todas las especies examinadas. También proporcionamos observaciones sobre el tamaño de camada para *P. cornutum, S. albiventris, S. jarrovii*, y *U. s. stejnegeri.*

Mexico has a highly diverse herpetofauna. For some of these species we know a good deal about their ecology and natural history. For others, we know very little. Even for some of the better known species, the knowledge often comes from one or a few populations. Here we report on the diets of one anuran and eight lizard taxa, as well as some observations on clutch size, from the Chihuahuan Desert and surrounding areas of Mexico based on specimens collected as part of a distributional and taxonomic survey of the Chihuhaun Desert and neighboring areas (Lemos-Espinal et al., 2002, 2004a; Smith et al., 2005)

Materials and Methods.

Lizards were collected by hand, preserved shortly after collection (initially in 10% formalin, and finally in 70% ethanol; specimens deposited in the Laboratorio de Ecologia of the Unidad de Biología, Tecnología y Prototipos), measured (snouth-vent length [SVL] to the nearest mm), and dissected to examine stomach contents and reproductive status. Diet items were identified to the lowest taxon possible, and measured for length and width using dial calipers to the nearest 0.1 mm. We then used BugRun 1.7 software to calculate prey volume (using the equation for a prolate spheroid) (see Vitt et al., 2005)

Results and Discussion.

Gastrophryne olivacea (Sonora).—Of the 22 individuals we examined, only two (9.1%) contained identifiable stomach contents. One individual contained a single beetle, and the other individual contained three ants. Previous work has suggested that *G. olivacea* is an ant specialist, but has also been known to eat beetles (Freiburg, 1951; Nelson, 1972).

Phrynosoma cornutum (Coahuila, Chihuahua).—Of the 6 individuals examined, four (66.7%) had identifiable stomach contents and two (33.3%) had empty stomachs. Termites and ants were equally important in the diet of *P. cornutum*, both numerically and volumetrically (Table 1). Lemos-Espinal et al. (2004b) found that ants dominated the diet of *P. cornutum* numerically, but that non-ant insects were important volumetrically. The diet of *P. cornutum* from the Chihuahua Desert was made up almost entirely of ants (Barbault and Maury, 1981; Blackshear and Richerson, 1999). Pianka and Parker (1975) reported 69% of prey items of *P. cornutum* were ants. Bott et al. (2001) observed *P. cornutum* feeding on termites in Arizona. These results are consistent with observed foraging (Whitford and Bryant, 1979) and morphological (Montanucci, 1989; Meyers et al., 2006) adaptations for consuming ants.

Table 1. Diet of *Phrynosoma cornutum* from Chihuahua and Coahuila.

Taxon	Number (%)	Volume (%) mm^3	Frequency
Coleoptera	2 (0.5%)	55.6 (0.6%)	1
Hymenoptera			
Formicid	184 (49.2%)	4289.7 (45.5%)	3
Other	1 (0.3%)	21.0 (0.2%)	1
Isoptera	187 (50.0%)	5395.9 (53.7%)	2

One female (SVL = 100.3 mm) contained 33 enlarged follicles. This is within the range of clutch sizes found throughout the distribution of *P. cornutum* (20 – 40; Parker, 1973; Ballinger, 1974; Pinka and Parker, 1975; Owens et al., 2002; Sherbrooke, 2002).

Phrynosoma orbiculare (Chihuahua).-- Both of the stomachs we examined contained identifiable stomach contents. We found a variety of insects in the two stomachs of *P. orbiculare* (Table 2). Numerically, ants were most important, however, beetles were a close second. Volumetrically, the diet of *P. orbiculare* was dominated by beetles. Pianka and Parker (1975) reported 67.5% of the prey items of *P. orbiculare* were ants. These observations are consistent with the generalist morphology of *P. orbiculare* and other "short-horned" species (Meyers et al., 2006).

Table 2. Diet of *Phrynosoma orbiculare* from Chihuahua.

Taxon	Number (%)	Volume (%) mm^3	Frequency
Coleoptera			
Adult	10 (32.3%)	1578.0 (77.1%)	2
Larvae	1 (3.2%)	59.0 (2.9%)	1
Hymenoptera			
Formicid	19 (61.3%)	363.1 (17.7%)	1
Other	1 (3.2%)	47.9 (2.3%)	1

Sceloporus albiventris (Chihuahua).—All eight of the *S. albiventris* contained identifiable stomach contents. The diet of *S. albiventris* is made up of a variety of insects (Table 3). Beetles were by far the most important prey item both numerically and volumetrically. We are not aware of any other reports on the diet of *S. albiventris*.

Four females contained eggs or follicles. The mean clutch size was 11.25 ± 0.48 eggs (range = 10-12). Mean SVL of these 4 females was 83.8 ± 5.0 mm (range = 72.1 – 94.0 mm).

Table 3. Diet of *Sceloporus albiventris* from Chihuahua.

Taxon	Number (%)	Volume (%) mm^3	Frequency
Coleoptera			
Adult	23 (59.0%)	2013.5 (53.7%)	5
Larvae	1 (2.6%)	46.8 (1.2%)	1
Diptera	1 (2.6%)	179.3 (4.8%)	1
Hemiptera	1 (2.6%)	15.2 (0.4%)	1
Homoptera	1 (2.6%)	34.4 (0.9%)	1
Hymenoptera			
Formicid	6 (15.4%)	78.2 (2.1%)	2

Sceloporus cyanostictus (Coahuila).—The one individual of *S. cyanostictus* that we observed contained 4 prey items: 3 beetles, and 1 bee. We are not aware of any other reports on the diet of *S. cyanostictus*.

Sceloporus jarrovii (Chihuahua, Sonora).-- Eleven of the twelve *S. jarrovii* we examined had identifiable prey items. The other individual had stomach contents, but they were not identifiable. The diet of *S. jarrovii* was made up of a variety of insects (Table 4). Numerically, ants and beetles were the most important prey items. Volumetrically, beetles and orthopterans were the most important. Caterpillars, orthopterans, and beetles were important prey items numerically and volumetrically in *S. jarrovii* from Durango, Mexico (Barbault et al., 1985). Ballinger and Ballinger (1979) found that preferred diet items of *S. jarrovii* from Arizona included hymenoptera, coleoptera, homoptera, orthoptera, and diptera. *Sceloporus jarrovii* from Arizona consume a variety of insects, with ants and beetles being the most important during the summer (Goldberg and Bursey, 1990).

Table 4. Diet of *Sceloporus jarrovii* Chihuahua and Sonora.

Taxon	Number (%)	Volume (%) mm^3	Frequency
Coleoptera			
Adult	14 (31.8%)	934.6 (43.5%)	7
Larvae	3 (6.8%)	84.0 (3.9%)	3
Ant Lion	1 (2.3%)	26.7 (1.2%)	1
Hymenoptera			
Formicid	18 (40.9%)	69.0 (3.2%)	4
Other	1 (2.3%)	55.6 (2.6%)	1
Lepidoptera	1 (2.3%)	27.1 (1.3%)	1
Orthoptera	5 (11.4%)	854.4 (39.8%)	4
Unident. Larva	1 (2.3%)	94.8 (4.4%)	1

We found a single female (SVL = 76 mm) containing 9 embryos. *Sceloporus jarrovii* from north-central Mexico had a mean litter size of 7.8 (Ramírez-Bautista et al., 2002). Mean litter sizes of *S. jarrovii* from Arizona ranged from 6.8 to 8.4 (Goldberg, 1971; Parker, 1973; Ballinger, 1979).

Uma paraphygas (Chihuahua).—All 4 individuals had identifiable prey in their stomachs. The diet of *U. paraphygas* was made up entirely of insects (Table 5). Termites were the most im-

Table 5. Diet of *Uma paraphygas* from Chihuahua.

Taxon	Number (%)	Volume (%) mm3	Frequency
Coleoptera			
Adult	1 (6.2%)	30.6 (9.1%)	1
Larvae	1 (6.2%)	24.9 (7.4%)	1
Hymenoptera			
Formicid	4 (25%)	238.0 (70.6%)	1
Isoptera	10 (62.5%)	43.6 (12.9%)	1

portant prey item numerically, but ants were the most important prey item volumetrically. In the sand dunes of the Bolsón de Mapimí, Chihuahua, *U. paraphygas* primarily eat ants for most of the year, but during the fall, hemipterans become important (Gadsden E. and Palacios-Orona, 1997).

Uta stansburiana elegans (Sonora).—All six individuals had identifiable stomach contents. The diet of *U. s. elegans* was made up entirely of insects (Table 6). Numerically, ants dominated the diet, followed by beetles. However, volumetrically beetles dominated the diet, followed by ants and coleopteran larvae. In Baja California Sur, *U. s. elegans* eat primarily insects and arachnids, with dipterans being the most important prey category (Galina-Tessaro et al., 1997). Asplund (1967) found ants and termites made up a large portion of the diet of *U. stansburiana* from Baja

Table 6. Diet of *Uta stansburiana elegans* from Sonora.

Taxon	Number (%)	Volume (%) mm3	Frequency
Coleoptera			
Adult	16 (27.1%)	372.4 (54.3%)	5
Larvae	3 (5.1%)	91.1 (13.3%)	2
Diptera	1 (1.7%)	54.5 (7.9%)	1
Hemiptera	1 (1.7%)	46.2 (6.7%)	1
Hymenoptera			
Formicid	36 (61.0%)	118.3 (17.2%)	5
Isoptera	2 (3.4%)	3.7 (0.5%)	1

California. In southeastern New Mexico, *U. stansburiana* eats a variety of insects and spiders (Best and Gennaro, 1984). Ants, orthopterans, and beetles are important prey for *U. stansburiana* from the Great Basin Desert (Parker and Pianka, 1975). Termites play a bigger role in the diets of *U. stansburiana* from the Mojave and Sonoran Deserts (Parker and Pianka, 1975).

Uta stansburiana stejnegeri (Coahuila).—Ten of the eleven *U. s. stejnegeri* had identifiable stomach contents. The other individual had an empty stomach. Insects made up the bulk of the diet of *U. s. stejnegeri*, but spiders were also found (Table 7). Termites made up almost two-thirds of the prey items observed. The next most numerically important taxa were beetles and ants. Volumetrically, termites and beetles were most important. In southeastern New Mexico, *U. stansburiana* eat a variety of insects and spiders (Best and Gennaro, 1984). Palacios-Orona and Gadsden-Esparza (1995) also found ants and termites were a numerically major component of the diet of *U. s. stejnegeri*, but larger prey types, such as beetles, caterpillars, and bugs, were important volumetrically. Ants, orthopterans, and beetles are important prey for *U. stansburiana* from the Great

Table 7. Diet of *Uta stansburiana stejnegeri* from Coahuila.

Taxon	Number (%)	Volume (%) mm³	Frequency
Araneae	2 (2.0%)	51.0 (7.4%)	2
Coleoptera	11 (11.2%)	203.4 (29.6%)	5
Ant Lion	1 (1.0%)	26.2 (3.8%)	1
Hymenoptera			
Formicid	17 (17.4%)	94.9 (13.8%)	6
Isoptera	65 (66.3%)	231.2 (33.6%)	2
Lepidoptera	1 (1.0%)	8.0 (1.2%)	1
Orthoptera	1 (1.0%)	72.4 (10.5%)	1

Basin Desert (Parker and Pianka, 1975). Termites play a bigger role in the diets of *U. stansburiana* from the Mojave and Sonoran Deserts (Parker and Pianka, 1975).

A female *U. s. stejnegeri* (SVL = 52 mm) contained a clutch of 3 eggs. Mean clutch size of *U. s. stejnegeri* from Durango, Mexico was 2.8 eggs (Gadsden et al., 2004). These values are at the lower end of the range of mean clutch sizes found throughout the distribution of *U. stansburiana* in the US (2.85 – 4.82; Hoddenbach and Turner, 1968; Parker and Pianka, 1975; Nussbaum and Diller, 1976; Goldberg, 1977; Bakewell et al., 1983; Ferguson et al., 1990; Zani, 2005).

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Physaloptera sp. (Nematoda: *Physalopteridae*) in the Arizona Mountain Kingsnake, *Lampropeltis pyromelana* (Serpentes: Colubridae)

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The Arizona mountain kingsnake, *Lampropeltis pyromelana* is found in central Utah and eastern Nevada, south in the mountains of Arizona and southwestern New Mexico into the Sierra Madre Occidental to southern Chihuahua, Mexico (Stebbins, 2003). We know of no accounts of parasites from *L. pyromelana*. The purpose of this note is to report the presence of larval *Physaloptera* sp. in *L. pyromelana*.

The digestive tracts from 234 *L. pyromelana* were examined for a study of food habits. Snakes were borrowed from the following museums (American Museum of Natural History, AMNH; Arizona State University, ASU; California Academy of Sciences, CAS; Carnegie Museum, CM; Field Museum of Natural History, FMNH; Museum of Southwestern Biology, MSB: Illinois Natural History Survey, INHS; Museum of Comparative Zoology, MCZ; Museum of Vertebrate Zoology, MVZ; Natural History Museum of Los Angeles County, LACM; San Diego Society of Natural History, SDSNH; University of Arizona, UAZ; University of Utah, UU; Western New Mexico University, WNMU). The ventral surface of the snakes was opened by a mid-ventral incision and the digestive tract was removed. It was slit open and the contents were examined under a dissecting microscope. One snake (UAZ 42065, from Prescott, Yavapai County, Arizona, collection date unknown) contained one nematode in the lumen of the stomach. The snake measured 562 mm SVL and had been preserved in 10% formalin and later stored in 50% isopropanol. The nematode was cleared in a drop of concentrated glycerol on a microscope. A cover glass was added and the temporary wet mount was examined under a compound microscope. It was identified as a 3rd stage larva of *Physaloptera* sp. Prevalence of infection (infected snakes/snakes examined X 100) was < 1%. The nematode was deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland as USNPC 94704.

Larvae of *Physaloptera* sp. are commonly found in amphibians and reptiles (Goldberg et al. 1993). Development beyond the larval stage does not occur and these parasites either die or are voided in feces. Since insects serve as intermediate hosts of members of the Physalopteridae (Anderson, 2000), infection is likely a byproduct of diet. *Lampropeltis pyromelana* is known to feed on lizards (Stebbins, 2003) so it likely becomes infected by feeding on prey that has ingested infected insects. *Lampropeltis pyromelana* might best be considered an accidental host. This is the first report of larvae of *Physaloptera* sp. in *L. pyromelana* .

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The Herpetofauna of a National Superfund Site in Erie, Pennsylvania

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Abstract.

The herpetofauna of the Harper Drive Hazardous Waste Area, a National Superfund Site, in Erie County, Pennsylvania was surveyed between 1995–1999, with two salamander, six frog and toad, three turtle, and four snake species being observed. The Spotted Turtle (*Clemmys guttata*), a species of special concern in Pennsylvania was found at the site. The base-line data presented in this report, along with any future surveys at the site, may be useful in evaluating the effects of remedial action on the areas herpetofauna.

Introduction.

The Harper Drive Hazardous Waste Area (now the Millcreek Golf Course) and adjacent land located west of State Rt. 832, east of State Rt. 299, and north of the CSXT Railroad tracks in Millcreek Township, Erie County, Pennsylvania (figure 1), consisted of ca. 80 acres of diverse habitats of swamp forest, temporary pools, old field, and small streams. Deciduous woods of Silver Maple (*Acer saccharinum*), Common Cottonwood (*Populus deltoides*), Red Oak (*Quercus* spp.), Tulip-tree (*Liriodendron tulipifera*), and Cherry (*Prunus* sp.) was also present. A small park (Linden Ave. Ball Park) located to the west of the landfill was used by local softball teams, and has since been converted into a flood retention basin. A portion of the site (ca. 60 acres) was used as an "un-

Figure 1. Map of the Harper Drive Hazardous Waste Area (HWA) and Linden Ball Fields (LBF). The site boundaries are approximate.

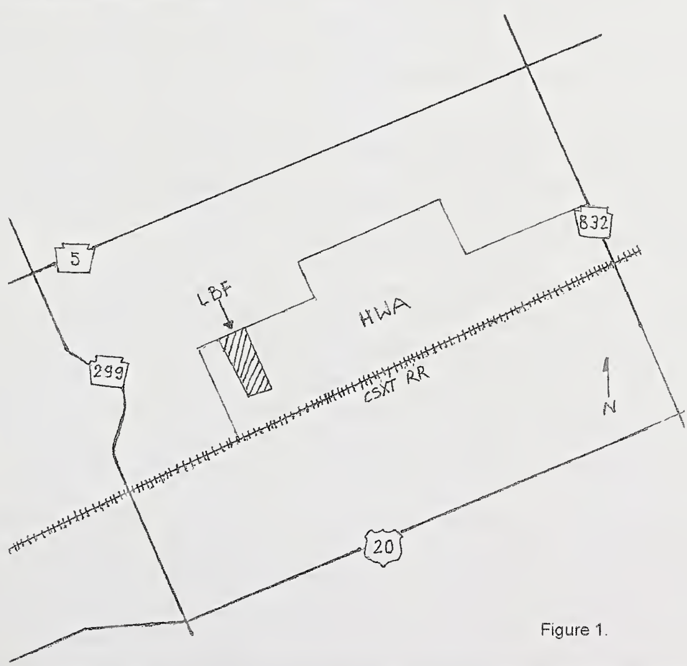

Figure 1.

permited active landfill" for foundry sand and municipal and industry waste from 1941 until 1981, at which time it was closed by the Department of Environmental Protection due to the presence of hazardous substances (McQuaid, 2000). The site was listed on the National Superfund Priority List in 1984. Between January 2000 and April 2002, the contaminated portion of the site was covered with a 12-inch soil cap, and a nine-hole golf course developed. Flood retention basins were also constructed adjacent to the golf course. Currently the site is managed by Millcreek Township.

The purpose of the present report is to provide information on the amphibians and reptiles occurring at the site prior to the construction of the golf course and flood retention basins.

Materials and Methods.

The site was searched for amphibians and reptiles by turning logs, rocks and man-made debris. Amphibians and reptiles were usually hand-captured; however, frogs and toads were occasionally identified by their species-specific calls, and turtles identified by the use of binoculars. The site was visited 96 times, for a total of approximately 127 hours as follows: 20 Mar. – 19 Aug. 1995, twelve visits (15 hrs. total); 5 Apr. – 1 Dec. 1996, twenty-five visits (32 hrs. total); 10 Mar. – 19 Sept. 1997, forty visits (56 hrs. total); 6 Jan. – 22 Oct. 1998, eighteen visits (23 hrs. total); one visit on 24 Apr. 1999 for one hour. Visits ranged from fifteen minutes (checking a den site), to approximately 3 – 4 hours searching various habitats. Searches were biased towards reptiles (snakes and turtles), with amphibians (frogs, toads, and salamanders) being found incidentally.

Results and Discussion.

Four hundred thirty three individuals of fifteen species (two salamander, six frog and toad, three turtle, and four snake species) were found at the site. Table one provides a summary of the total number of individuals observed and the capture rate (number of individuals /per unit of time) of each species. The capture rates of amphibians are likely to be under-estimations, as they were usually encountered while searching for reptiles. For example, all post-metamorphic *Ambystoma maculatum* were found while searching debris piles for snakes, and most frogs were observed while looking for turtles. Due to their low survivorship, amphibian larvae were not included in the counts.

Salamanders were infrequently seen at the site, with only two species, the Spotted Salamander (*Ambystoma maculatum*) (n=4) and the Eastern Newt (*Notophthalmus viridescens*) (n=1) being observed. Both species were found beneath logs and debris in the vicinity of the swamp. Eggs of *A. maculatum* were observed in the swamp (13 May 1997) and in a temporary pool near the Linden Ball Fields (21 Apr. 1997; 28 Apr. 1998).

Frogs and toads were the most diverse group at the site, with six species noted. The rarest was the Wood Frog, *Rana sylvatica* which was represented by a single calling individual. The most abundant frog was the Green Frog, *R. clamitans melanota* (n=44) which was observed near water throughout the site. Evidence of reproduction (e.g. larvae) was observed for the American Toad, *Bufo americanus*; Gray Treefrog, *Hyla versicolor*; Spring Peeper, *Pseudacris crucifer;* and Green Frog, *R. c. melanota*. Both *H. versicolor* and *R. sylvatica* were restricted to the swamp, while the other species were observed in various portions of the site, especially near water.

Three species of turtle were present: Common Snapping Turtle, *Chelydra serpentina*; Midland Painted Turtle, *Chrysemys picta marginata*; and Spotted Turtle, *Clemmys guttata*. The Spotted Turtle was the rarest, with only five individuals sighted. The status of *Clemmys guttata* in Pennsylvania is currently undetermined, although declines are suspected. As of January 2007, the Pennsylvania Fish and Boat Commission have closed the season on this species. At the time of the survey, the population appeared to be very small and in danger of extirpation. The author has not

Table 1. Capture rates (CR = no. individuals observed/search effort) for amphibians and reptiles at the Harper Drive Hazardous Waste Area, Erie County, Pennsylvania, 1995-1999.

Salamanders		**'95 CR**		**'96 CR**		**'97 CR**		**'98 CR**		**'99 CR**		**total CR**
Ambystoma maculatum	0	(n=0)	0.06	(n=2)	0.04	(n=2)	0	(n=0)	0	(n=0)	0.03	(n=4)
Notophthalmus viridescens	0.07	(n=1)	0	(n=0)	0	(n=0)	0	(n=0)	0	(n=0)	0.01	(n=1)
Frogs and Toads												
Bufo americanus	0	(n=0)	0.03	(n=1)	0	(n=0)	0.09	(n=2)	0	(n=0)	0.02	(n=3)
Hyla versicolor	0	(n=0)	0.06	(n=2)	0.04	(n=2)	0	(n=0)	0	(n=0)	0.03	(n=4)
Pseudacris crucifer	0	(n=0)	0.06	(n=2)	0.21	(n=12)	0.35	(n=8)	0	(n=0)	0.17	(n=22)
Rana clamitans melanota	0.2	(n=3)	0.12	(n=4)	0.55	(n=31)	0.26	(n=6)	0	(n=0)	0.35	(n=44)
R. palustris	0	(n=0)	0.06	(n=2)	0.09	(n=5)	0.04	(n=1)	0	(n=0)	0.06	(n=8)
R. sylvatica	0	(n=0)	0	(n=0)	0.02	(n=1)	0	(n=0)	0	(n=0)	0.01	(n=1)
Turtles												
Chelydra serpentina	0.33	(n=5)	0.06	(n=2)	0.05	(n=3)	0	(n=0)	0	(n=0)	0.08	(n=10)
Chrysemys picta marginata	0.13	(n=2)	0.28	(n=9)	0.91	(n=51)	0.39	(n=9)	0	(n=0)	0.56	(n=71)
Clemmys guttata	0	(n=0)	0.03	(n=1)	0.08	(n=4)	0	(n=0)	0	(n=0)	0.02	(n=5)
Snakes												
Lampropeltis t. triangulum	0.13	(n=2)	0.06	(n=2)	0.14	(n=8)	0.35	(n=8)	0	(n=0)	0.16	(n=20)
Storeria d. dekayi	0.2	(n=3)	0.19	(n=6)	0.68	(n=38)	0.43	(n=10)	0	(n=0)	0.44	(n=57)
S. o. occipitomaculata	0	(n=0)	0.03	(n=1)	0	(n=0)	0	(n=0)	0	(n=0)	0.01	(n=1)
Thamnophis s. sirtalis	0.33	(n=5)	0.41	(n=13)	2.09	(n=117)	1.96	(n=45)	4	(n=4)	1.45	(n=184)
annual CR	1.4	(n=21)	1.47	(n=47)	4.89	(n=274)	3.87	(n=87)	4	(n=4)		(n=433)

seen a Spotted Turtle at the site since 4 June 1997. The Midland Painted Turtle was the most commonly observed (n=71) turtle, and was restricted to the swamp. Evidence of successful reproduction of *C. p. marginata* included the observation of hatchlings (n=2) and individuals under 3 years old (n=3). Two female Painted Turtles were observed nesting in sandy soil north of the swamp on 23 June 1996. Snapping Turtles (n=10) were primarily observed in the swamp, but also in the small stream west of Linden Ball Field. A DOR *C. serpentina* (not included in the count) was found on Powell Avenue, just north of the bridge.

Snakes were represented by four species: Eastern Milk Snake, *Lampropeltis triangulum triangulum*; Northern Brown Snake, *Storeria dekayi dekayi*; Northern Redbelly Snake, *S. occipitomaculata occipitomaculata*; and Eastern Garter Snake, *Thamnophis sirtalis sirtalis*. Snakes were most often found beneath cover in open grassy areas, with the exception of early spring, when Garter Snakes were found in good numbers, basking at den sites. The least observed was the NorthernRedbelly Snake, with only a single individual captured while moving across a trail, bordered by field habitat. Prior to the present survey (ca. mid to late 1980's), the author found a melanistic individual under some roofing shingles, south of the Linden Ball Fields. The specimen was black dorsally, with a bright reddish orange ventral surface. The overall capture rate (CR = 0.01) of *S. o. occipitomaculata* at the Harper Drive site was similar to that reported for the species at other Erie County sites (e.g. Asbury Woods Greenway [Gray, 2006]; West Springfield [Gray, unpublished data]). *Storeria o. occipitomaculata* is known to be secretive and nocturnal most of the year (Ernst and Ernst, 2003). Due to these behaviors, and the fact that the snake surveys were diurnal, this species may have been more abundant than noted in this report. The Eastern Garter Snake, *T. s. sirtalis* was the most abundant serpent at the site, with 184 individuals observed. On 14 April 1997, more than twenty *T. s. sirtalis* were observed at a den located just SSW of the Linden Ball Fields. Evidence of reproduction, consisting of gravid females and the presence of young of the year individuals was noted in *L. t. triangulum, S. d. dekayi,* and *T. s. sirtalis*. Gray et al. (2001) and Gray et al. (2003) reported on abnormalities in the litters of female *T. s. sirtalis* obtained from the Harper Drive site.

The construction of a nine-hole golf course and flood retention basins has greatly altered habitats at the site. The den site mentioned above, utilized by both *S. d. dekayi* and *T. s. sirtalis* was destroyed by the construction of a flood retention basin; whereas turtle nesting sites, as well as den sites were destroyed by the development of the golf course. The data presented in this report may be useful in evaluating the effects of alterations that have occurred at the site. Any future surveys of the site should be designed so that search effort is divided equally among groups, thus making comparison of capture rates more meaningful. In addition, the status of the Spotted Turtle, *C. guttata* at the site should be a priority of any subsequent study.

Acknowledgments.

I wish to offer my thanks to Mark Lethaby for reviewing a draft of the manuscript, and offering suggestions that improved it.

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A Replacement Name For *Thamnophis eques obscurus* Conant

Conant (2003) named seven new subspecies of *Thamnophis eques* from lakes of the Transvolcanic Province of southern Mexico. Only one of the epithets, *obscurus*, is descriptive, and is also preoccupied within *Thamnophis*. *Eutaenia sirtalis* subsp. *obscura* (Cope, *In* Yarrow 1875) is based on five syntypes (USNM 974), from "Westport, Essex County, New York" (Cochran 1961), and is currently a synonym of *Thamnophis sirtalis sirtalis* (Boundy 1999). *Thamnophis eques obscurus* (Conant 2003) is based on AMNH 87543 (holotype), from "the town of Chapala, Jalisco, Mexico." Because *T. e. obscurus* is a junior homonym of *E. s. obscura*, I propose the replacement name ***Thamnophis eques kiwi***, which bears the same holotype as *T. e. obscurus* Conant. The subspecific epithet is based on Kiwi® shoe polish; the subspecies in question resembles other *T. eques*, except that it appears to have been shined with "Cordovan."

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News and Notes

A Field Guide to Amphibians and Reptiles in Arizona, by Thomas C. Brennan and Andrew T. Holycross. 2006. vi + 150 pp. Arizona Game and Fish Department, Phoenix, AZ. ISBN 0-91756543-0 And **Field Guide to Amphibians and Reptiles of Maricopa Couunty,** by Thomas C. Brennan and Andrew T. Holycross. 2005. iv + 68 pp. Arizona Game and Fish Department, Phoenix, AZ ISBN 0-911563-52-2. $12.50 and $5.00 respectively.

When one considers the number of herpetologists and species diversity in Arizona, it is surprising that only scattered papers have appeared regarding native herpetofauna, in herpetological journals. And only a very few relating to the entire fauna of the state. The first major work was published by Fowlie (1965) consisting of a book on the snakes of Arizona, with black-and-white photographs, while others such as Lowe (1964, 1996), Lowe et al. (1986), and Lazaroff et al. (2006) are restricted to more local regions, or on venomous serpents found within the state.

The authors of "*A Field Guide to Amphibians and Reptiles of Arizona,*" provide the first reference covering the herpetological fauna of Arizona, and certainly fill a much needed gap by providing both the naturalist and herpetologist with a complete guide to all the 142 native and non-native species found in Arizona. The book, "*A Field Guide to Amphibians and Reptiles of Arizona,*" is a welcome edition but not as comprehensive a review in the same catagory as the majority of the more recent state herpetological books.

The "Field Guide to Amphibians and Reptiles of Maricopa County," by the same authors is another compact volume easily carried in the pocket, with superb color illustrations.

The monograph "*A Field Guide to Amphibians and Reptiles in Arizona*" provides an excellent introductory chapter, with color photographs of the fourteen recognized biotic communities found within Arizona, along with a color map of the state showing their distribution of these communities. The authors discuss the vegetation, topography, elevation ranges, and associated herpetofauna for each of these communities. This will provide a useful chapter for familiarizing people visiting, or living in Arizona that are not familiar with the diversity of habitats found within their state.

This is followed by the species accounts and excellent color photographs of the 132 species of native amphibians and reptiles from within Arizona. It is not surprising that with the diversity of habitats, Arizona harbors 14 highly venomous snakes, and one lizard. Of the 14 venomous snakes, 13 are highly venomous rattlesnakes, along with an additional single species of elapid, the coral snake. The species accounts are quite short (up to four pages), but filled with information on behavior, habitats, food, reproduction and physical characteristics. Each of the species that are non-native, venomous, or protected within the state are clearly identified within the text. Subspecies are not discussed in the species accounts. The species *Lampropeltis getula* (Common Kingsnake) is cited as having three polymorphic forms with the state of Arizona, which are identified only by the standard English names, along with illustrations. Also the species *Lampropeltis triangulum* (Milk Snake) and *Crotalus organanus* (Western Rattlesnake) are cited as having two color phases within the state.

The color illustrations are excellent overall and presented against a white background. In the majority of the cases only one photograph is provided per species, but where there are two or more distinct geographic forms, or where juvenile color pattern differs from the adults, multiple photographs are provided. The majority of the photographs have been provided by the authors, and a list of credits for other photographs are provided in the back of the book. Line drawings have been provided by Randy Babb or the senior author.

Each species account includes a range map consisting of a small map of Arizona and its counties. The species distributions are portrayed with color shading, based on museum records. Current ranges of native species are shown in green, whereas areas where a species is presumed extripated are in yellow. Introduced species ranges are shown in red.

Both the scientific and common English names are remarkably current and closely follow Crother et al. (2000, 2003), with a few exceptions based on more recent revisions by more recent publications.

The species accounts are followed by a glossary of terms used in the text, followed by a species index and checklist for those using the book and wishing to record species having been seen within the state of Arizona.

The authors feel that anyone interested in herpetology should have a copy of both these books even if you have no intention of visiting the state at a later date. The excellent illustrations and highly affordable price will make these books available to anyone having an interest in the natural history of the state, or herpetology in general.

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News and Notes

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News and Notes

FIELD GUIDE TO AMPHIBIANS AND REPTILES OF THE SAN DIEGO REGION, by Jeffrey M. Lemm. 2006. University of California Press, Berkeley. 326 pp. + 160 color photographs. Cloth $60.00, Paper $24.95. ISBN 978-0-520-24573-0 & ISBN 978-0-520-24574-7.

The excellent cover design of a specimen of Large-blotched Ensatina *(Ensatina klauberi)* on the paper edition will certainly catch any person's prompt attention.

Having seen all the field guides on North American amphibians and reptiles, this guide has taken a somewhat different twist, by adding excellent photographs of each of the eighty-eight species found within the San Diego Region and a distributional map following each species description. This book serves as more than a field guide, it is an up-to-date, authoritative, conservation-oriented book.

The San Diego region is considered one the world's hotspots, as it contains a high number of endangered and threatened species. Two species, the California Red-legged Frog *(Rana draytonii)* and Mountain Yellow-legged Frog *(Rana muscosa)* are probably extirpated from the fauna, four species of sea turtles, Desert Tortoise *(Gopherus agassizii)*, Switakis's Banded Gecko *(Coleonyx switaki)*, Common Chuckwalla *(Sauromalus ater)*, and San Diego Ring-necked Snake *(Diadophis punctatus similis)* are considered endangered or threatened species, with another twenty-one species considered of special concern, and fully protected by federal or state laws. Jeffrey M. Lemm provides information on identification, habitats, ecology, and the conservation status of all eighty-eight species found within the San Diego region. Many of these species are also widely distributed throughout Southern California and extending into Northern Baja California.

A new, easy-to-use taxonomic key by the renowned herpetologist Jay M. Savage, along with line drawings of tadpoles and egg masses of amphibians will help make species identification much easier.

The introduction provides an excellent review of the topographical features of San Diego County, which stretches from the Orange County line near Camp Pendleton to the U.S.-Mexico border, or roughly nearly seventy miles southward. A brief review of the geological history and major habitats in San Diego County, which has been divided into seven major habitat types, are illustrated with two color maps showing the limits of the area under study.

This is followed by a discussion of the problems facing the conservation of the local fauna with the ever-growing population growth of humans, along with comments on how measures are being taken to protect and preserve natural populations within the San Diego County area.

The species accounts make up the greater bulk of this volume with both the common and scientific names, followed by an excellent description, and natural history notes consisting of remarks on habitat, activity pattern and reproduction. These are followed by remarks on the conservation status, as well as taxonomic notes when necessary. Each account is provided with black and white illustrations of egg masses and tadpoles for amphibian species, along with a distributional map and excellent color photograph of each species found within the San Diego Region.

The species accounts are followed by a chapter by Gretchen E. Padgett-Flohr on amphibian chytridiomycosis with emphases on *Batrachochytrium dendrobatidis*, Chytrid fungi has become a parasitic fungi and can be a fatal disease for postmetamorphic amphibians. This chapter is followed by remarks on current research and a short index of references on the disease.

This is followed by a chapter on snakebite and venom by Sean Bush, with emphases on

snakebite in California, along with a literature cited section, followed by a species checklist, glossary, excellent literature cited references and index.

The authors would highly recommend this valuable guide as it will certainly be a useful to anyone visiting southern California, and especially those enthusiasts, nature-lovers, and professionals alike.

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News and Notes

AMPHIBIANS, REPTILES, AND THEIR HABITATS AT SABINO CANYON. By David W. Lazaroff, Philip C. Rosen and Charles H. Lowe, Jr. 2006. Univ. Arizona Press, Tucson. xv + 158 pp. ISBN 0-8165-2495-5. Soft cover $15.00.

The author D.W. Lazaroff has spent a decade studying the fauna of Sabino Canyon while working as an environmental education specialist for the Colorado National Forest, while P.C. Rosen an ecologist at the University of Arizona having studied aquatic and riparian desert amphibians and reptiles, and the noted authority of the herpetofauna of Arizona the late, Charles H. Lowe has published extensively on the fauna of Arizona, with particular emphasis on the herpetofauna.

In the first chapter the authors provide a highly black and white illustrated discussion on the five major topographic features, and locations within the Sabino Canyon. This is followed by a short introduction on climate, and more lengthy review of the six biotic communities, which are also illustrated with b/w figures for each biotic community.

This is followed by an introduction to aquatic communities within the Sabino Canyon area, with four categories being recognized, and followed by a chapter on ecological changes in the Sabino Canyon by drought, fire, changing stream flow patterns, imported predators, non-native plants and released pets, along with human pressure on this critical natural area.

The major portion of the book provides information on the nine species of amphibians, and forty three species of reptile species having been observed or collected in Sabino Canyon, or just outside the park limits, yet expected to be found within the boundary of the park.

The authors provide the common name, scientific species name, without any comments regarding subspecies recognition. Followed with notes on abundance, habitat, distribution and a general description, along with a distributional map of Sabino Canyon populations. Six color photographs are provided, along with forty-five black and white figures following each species account.

Four appendix provide checklists for species of plants and animals other than amphibians and reptiles, followed by a list of photographic station localities, English and Metric conversion units. The third appendix summarized important events in the environmental history of Sabino Canyon since 1906 until 2005, followed by a checklist of the fifty-six species of amphibians and reptiles that would/should be found within the Sabino Canyon recreational area.

The book closes with a short bibliography of eighteen citations and index.

For those naturalists visiting Arizona, or having been to Sabino Canyon, we would highly recommend having this book in their library.

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Society Publication

Back issues of the Bulletin of the Maryland Herpetological Society, where available, may be obtained by writing the Executive Editor. A list of available issues will be sent upon request. Individual numbers in stock are $5.00 each, unless otherwise noted.

The Society also publishes a Newsletter on a somewhat irregular basis. These are distributed to the membership free of charge. Also published are Maryland Herpetofauna Leaflets and these are available at $.25/page.

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All correspondence should be addressed to the Executive Editor. Manuscripts being submitted for publication should be typewritten (double spaced) on good quality 8 1/2 by 11 inch paper with adequate margins. Submit original and first carbon, retaining the second carbon. If entered on a word processor, also submit diskette and note word processor and operating system used. Indicate where illustrations or photographs are to appear in text. Cite all literature used at end in alphabetical order by author.

Major papers are those over five pages (double spaced, elite type) and must include an abstract. The authors name should be centered under the title, and the address is to follow the Literature Cited. Minor papers are those papers with fewer than five pages. Author's name is to be placed at end of paper (see recent issue). For additional information see *Style Manual for Biological Journals* (1964), American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

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